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# BANGKOK FAO TECHNICAL CONSULTATION ON POLICIES FOR SUSTAINABLE SHRIMP CULTURE

Bangkok, Thailand, 8-11 December 1997

Documentos presentados a la

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# CONSULTA TÉCNICA FAO/BANGKOK SOBRE POLÍTICAS PARA EL CULTIVO SOSTENIBLE DEL CAMARÓN

Bangkok, Tailandia, 8-11 de diciembre de 1997

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## PREPARATION OF THIS DOCUMENT

This document contains the papers submitted by the FAO Secretariat, delegates, observers and resource persons to the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture, Bangkok, Thailand, 8-11 December 1997. Some papers were edited for language and compliance with FAO nomenclature. Except for the papers submitted by the FAO Secretariat, the views expressed in these papers are those of the author(s) and should not be attributed to FAO.

The Report of the Bangkok Consultation on Policies for Sustainable Shrimp Culture has been published as FAO Fisheries Report No. 572. The Report is also available on the home page of FAO's Fisheries Department: http://www.fao.org/fi/FAOCONS/shrimp/bangk.asp.

## PREPARACION DE ESTE DOCUMENTO

Este es el informe sobre los trabajos presentados por la Secretaría de la FAO, los delegados, observadores y científicos especiales invitados a la Consulta Técnica FAO/Bangkok sobre Políticas para el Cultivo Sostenible del Camarón, Bangkok, Tailandia, 8-11 de diciembre de 1997. Algunos documentos fueron editados en lo que concierne al estilo y para cumplir con la nomenclatura de la FAO. Con excepción de los documentos presentados por la Secretaría de la FAO, las opiniones contenidas en estos documentos son aquellas del autor/autores y no deberían ser atribuidas a la FAO.

El Informe de la Consulta sobre Políticas para el Cultivo Sostenible del Camarón ha sido publicado como Informe de Pesca de la FAO No. 572. El Informe está también disponible en el sito internet del Departamento de Pesca de la FAO http://www.fao.org/fi/FAOCONS/shrimp/bangk.asp

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## ABSTRACT

This document contains the papers submitted by the FAO Secretariat, delegates, observers and resource persons to the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture, Bangkok, Thailand, 8 to 11 December 1997. The papers comprise background information and discussion guidelines by the FAO Secretariat, descriptions and analyses of shrimp culture development and management including legal and institutional aspects and government policies of several of the main producing countries, accounts of current activities and views on shrimp culture by several intergovernmental and non-governmental organizations, and a review of the literature on this subject focusing on development economics and socio-economics issues.

## RESUMEN

Este documento contiene los trabajos presentados por la Secretaría de la FAO, delegados, observadores y científicos especiales invitados a la Consulta Técnica FAO/Bangkok sobre Políticas para el Cultivo Sostenible del Camarón, Bangkok, Tailandia, 8-11 de diciembre de 1997. Los trabajos incluyen antecedentes de información y directrices para discusión por parte de la Secretaría de la FAO, descripciones y análisis de la ordenación y desarrollo del cultivo de camarón incluyendo los aspectos legales e institucionales y las políticas gubernamentales de varios de los principales países productores, informes sobre las actividades en curso y opiniones sobre el cultivo de camarón por parte de varias organizaciones intergubernamentales y no gubernamentales, y un examen de la literatura sobre este tema focalizado en economía del desarrollo y cuestiones socioeconómicas.

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# PROSPECTUS

## Background

There are few economic activities which globally have depicted such high growth rates as the culture of shrimp in coastal areas during the last decade. This rapid development has been accompanied by increasingly controversial debates over the environmental, social and economic impacts of shrimp culture. There is considerable uncertainty about appropriate policy and management responses, not least because of the perception that shrimp culture generates substantial benefits in coastal regions and at national levels.

The causes for high growth rates included technological progress and high market demand, especially in Japan, USA and Europe, as well as stagnating or reduced supplies from wild stocks, many of which are over-exploited. High growth rates were also made possible by two features: First, many governments, often assisted by bilateral and multilateral donor agencies, actively supported the development of export-oriented shrimp culture in order to earn foreign exchange. This support ranged from the provision of subsidised credits to government sponsored extension and training schemes. Second, planning exercises, if any, and the issue of permits for the siting and operation of shrimp farms in the coastal areas were speedily undertaken. Thus, at the origin of the impressive growth rates of shrimp culture lie the economic incentives created by high returns on investment, or expectations thereof, and the speed at which new farms could be established. While these conditions could be taken as healthy signs of economic development, there is evidence that the governmental planning and regulatory frameworks were in several instances inadequate to ensure that private returns on shrimp culture could be sustained and the expected societal benefits fully realised.

In the absence of effective regulations and/or changes of economic incentives through fiscal policies (e.g. taxes, fees, etc.), tradable quotas or other measures, shrimp culture is generally subject to problems of market failure in the allocation of scarce resources. Effective markets are typically absent or inadequate for important production inputs, especially land, fresh water and specific valued environments such as mangroves. Market failure is also caused by the externalities associated with the discharge of untreated effluents into the aquatic environment which is used in common by neighbouring farms to renew pond water. The decrease in water quality reduces growth rate and resilience of the animals against diseases and may directly spread viral contamination. The consequence of such types of market failure is that entrepreneurs get wrong price signals about the true costs of production and hence make sub-optimal decisions on production technology and intensity, siting of ponds, and waste treatment measures.

Market failure usually also affects the way how the benefits and costs of an economic activity accrue to different people. In some instances, shrimp culture did not directly benefit local communities but impeded people's traditional access to common property resources and reduced their availability through depletion and degradation. A typical example is the excessive withdrawal of groundwater resources from coastal aquifers causing a lowering of the water table and intrusion of saltwater which affected the fresh water supplies of coastal communities. This and other adverse impacts of shrimp culture on coastal communities and environments have in some cases given rise to severe social conflicts which in recent years has discredited this activity in the eyes of many local, national and international non-governmental organizations. The negative position of these organizations is in contrast to the perception of policy-makers, planners and others who refer to the many beneficiaries of shrimp culture including small-scale farmers and large numbers of often low-income people who are employed in seed collection, shrimp processing and other ancillary activities.

## Objective

The objective of the Technical Consultation is to contribute to the preparation of guidelines containing policy options and methodologies for government policy-makers and, especially planners, to develop an appropriate incentive structure and regulatory and decision-making framework for the development of sustainable shrimp culture. The guidelines will support the implementation of the Code of Conduct on Responsible Fisheries including relevant provisions contained in its Article 9 "Aquaculture Development", and may facilitate the development of voluntary self-regulatory schemes implemented by farmer groups or industry associations.

## Scope

The Consultation will provide a forum for the discussion of the following aspects of shrimp culture development in the coastal zone: (1) legal and institutional framework for planning, regulating, monitoring and enforcement; (2) planning and regulatory methods (e.g. integrated planning; resources valuation techniques; economic incentives/disincentives; tradable rights; direct regulations); (3) policy measures affecting the distribution of net benefits of shrimp culture; (4) identification of siting and farm management aspects requiring the setting and enforcement of production standards; and (5) measures to achieve consensus and to resolve conflicts including participatory planning approaches and arrangements for arbitration and dispute settlement. Some time of the Consultation will be reserved for a discussion of the kind of follow-up which should be taken by FAO.

## Documentation

The documentation for the Technical Consultation will include written contributions by participants and participating institutions and a detailed discussion guide by FAO. The written contributions will include a summary of important prior publications on this subject; case studies of the economic, social and environmental impacts of shrimp culture in the coastal zone and its macro-economic benefits; case studies of planning methods and regulatory measures applied by governments; and, a review of selected national legislation pertaining to shrimp culture in coastal zones.

## Collaborating Organizations

The Consultation is organized and partly financed by FAO. As of July 1997, the following organizations have agreed to support the Consultation technically: INFOFISH (International Organization for Marketing Information and Technical Advisory Services for Fishery Products in the Asia and Pacific Region); NACA (Network of Aquaculture Centres in Asia and the Pacific); and SEAFDEC (Southeast Asian Fisheries Development Centre). An indication of possible support has been obtained from the Environment Department of the World Bank. Governments, non-governmental organizations and private industry will be invited to contribute technically and financially to the Consultation.

## Output

The principal output expected from the Technical Consultation is detailed advice on the target groups, contents and ways of dissemination of guidelines on policies for sustainable shrimp culture to be prepared following the Consultation.

## Participants and Venue

The participants (approx. 35) of the Consultation will include government staff and academics/researchers dealing with aquaculture, planning and environment management in various disciplines including economics, biology and legislation; staff of multilateral agencies and of non-governmental organizations representing different interests including industry, environment and development. The Consultation will take place over a period of 5 days from 8th to 12th December 1997 at the FAO Regional Office for Asia and the Pacific (RAP), Maliwan Mansion, 39 Phra Atit Road, Bangkok 10200, Thailand.

## Technical Secretariat

The FAO Fisheries Department has designated Mr Rolf Willmann, Fishery Policy and Planning Division, as the Technical Secretary of this Consultation. He can be contacted as follows:

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## SUMMARY OVERVIEW OF THE LITERATURE ON SHRIMP CULTURE

### Introduction

This summary overview attempts to provide a brief account of the main trends observed in the literature on shrimp culture over the last two decades. Its objective is to identify important gaps in our understanding of this sector in order to focus future research efforts aimed at improving management policies and practices. No claim is made, however, of completeness in terms of coverage of the more than 600 references compiled in a recent literature survey.[1]

### Major Trends

Modern kinds of shrimp culture in coastal ponds have developed during the last two decades with most expansion taken place within the last decade. Much of the literature in the initial years of the onset of modern shrimp culture addressed various kinds of technological issues related to pond and farm design, composition and doses of feed, seed supply and stocking intensities and others. Crucial determinants of production costs in this period were the initial investment costs in the construction of ponds, water inflow and outflow channels, dikes, access roads and other ancillary infrastructure. Operating costs were kept low through the use of tidal action which required that ponds be located in low-lying areas close to the coast. Frequently, these areas were in mangroves which had been partly already used seasonally for traditional systems of mixed shrimp and fish culture. This fact has from about the early 1980s led to first voices of concern about the removal of mangroves through shrimp culture. This concern was based on ecological and socio-economic grounds with respect to the habitat, coast line protection and other valued ecological functions of mangroves and with respect to their multiple uses by primarily rural populations which derived important subsistence benefits from these high productive ecosystems. Experiences made in these years with the problems associated with soil acidification led by at least the mid-1980s to the accepted view that mangrove areas do not usually offer optimal conditions for modern types of shrimp pond culture. This led to a decline in the rate of utilization of mangroves for shrimp culture but did not entirely stop the location of shrimp ponds in these areas for various reasons including difficulties faced by governments to effectively enforce mangrove protection legislation.

In some countries (e.g. Thailand), detailed estimates have been made in recent years to quantify the extent of mangrove losses associated with shrimp culture. These studies confirm the significant slow down in the conversion of mangroves for pond culture. There are only few studies which have attempted to valuate in economic and social terms the losses associated with the removal of mangroves. There remain significant knowledge gaps in quantifying, for example, the losses in the abundance of wild fish stocks and crustaceans which can be attributed to the decline in mangrove areas. This task is made difficult not least because of the often strong impact of overcapitalized marine capture fisheries on the same stocks as well as the large climate related variability in the recruitment of these species. Similarly, the coast protection benefits of mangrove forests have been proven hard to quantify. On the other hand, the increasing concern about conserving biological diversity as internationally codified in the Convention on Biological Diversity, places most or all mangrove ecosystems in the rank of priority areas for protection and for multiple use patterns within sustainable limits. Therefore, even in the unlikely event that future studies were to indicate that the immediate ecological and socio-economic benefits have been overestimated in earlier assessments, their conservation and possible restoration would remain incontestable objectives. As a consequence, one important area for future research would likely be on cost-effective and socio-economic beneficial ways of mangrove restoration under various climatic and geo-physical conditions. Very recent studies on the use of the assimilative capacity of mangrove areas to treat effluents of shrimp ponds, indicate the potential for complementary interests between mangrove conservation and restoration and shrimp culture.

The realization of the unsuitability of mangrove areas for shrimp cultivation implied that ponds needed to be constructed in areas which were already utilized for agriculture, primarily rice cultivation, or elsewhere in coastal areas. Concurrently, shrimp culture technology improved significantly in the fields of hatchery rearing of seed, feed composition and manufacturing, feeding strategy, stocking density, and sanitary and health management, which increased dramatically attainable production per unit area. These increases in productivity were crucial for maintaining the farmers' competitiveness in an international shrimp market where rapid increases in global supplies had caused a real decline in shrimp prices in the late 1980s and early 1990s.

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[1] FAO contracted the Centre for the Economics and Management of Aquatic Resources (CEMARE), University of Portsmouth, UK, to undertake a review of the literature on shrimp culture with a focus on policy and management issues. While the resultant publication made available at this Consultation does not represent the view of FAO, the present document draws upon several of the findings of this review.

The move towards more intensive high input culture systems fuelled by technological advances, international competition and relative land-scarcity in especially the Asian region, led to new kinds of concerns which came to the fore since the late 1980s, and to global attention in recent years. These included dramatic production losses caused by epidemic outbreaks of viral diseases; overutilization of the waste assimilation capacity of nearshore waters and fresh water aquifers; obstruction of access to communal resources by coastal communities; nutritional, socio-economic and cultural impacts of conversion from agricultural multi-crops including paddy to shrimp culture; and in some instances, forced land eviction of peasants. Whereas in Asia especially, much of shrimp culture is undertaken by small and medium sized farms, the problems created in shrimp farming are in much of the literature primarily associated with the commercial interests of large corporations involved in shrimp culture, the supply of crucial inputs such as feed and chemicals, and/or in shrimp processing, marketing and distribution. While no one could deny that large corporations are among the important beneficiaries of the expansion of shrimp culture, the economic dependency of large numbers of shrimp farmers, seed collectors and those involved in shrimp processing and ancillary activities cannot be ignored in the discussion about the future course of this activity. It is the benefits but also the burdens of the latter which appear to have been squarely ignored in much of the literature.

Several of the most recent literature has made valuable and constructive suggestions how shrimp fisheries should be conducted in a sustainable manner and about the kind of incentives which need to be created to encourage farmers, input suppliers, and others to adopt good practices. These suggestions range from the better integration of shrimp culture into coastal area management, to higher efficiency in the use of various inputs to reduce the drawing down of natural resources and the waste load into the environment, and to measures to increase the generation of economic and social benefits at the local level in particular.

In relation to aquaculture development in general, the Code of Conduct for Responsible Fisheries reflects in Article 9 a broad based international consensus on the principles which should be followed in pursuing aquaculture in a sustainable and responsible manner. There is an evolving consensus that action is needed at several levels to advance these principles in shrimp culture including the individual farmer, groups and associations of farmers, input suppliers, shrimp distributors and marketers as well as at the levels of local, provincial and national governments. There is also an evolving consensus that all these actors are going to gain from improved practices and better public regulatory systems. However, there appears to be insufficient appreciation of the difficulties which need to be overcome in terms of increasing the know how of farmers and their ability to change their practices, their access to technology and finance, their organization in groups and associations, the ability and capacity of local, provincial and national governments to improve their regulatory practices and law enforcement, the ability of suppliers to control the activities of their local agents, assistance to seed collectors to shift to other occupations, and others. In the absence of a realistic assessment of these human, financial and organisational requirements in the different countries and coastal areas, unattainable objectives and time frames for reaching them might be laid down for existing shrimp culture. This may then create unfulfillable expectations among the public at large and among those consumers whose purchasing behaviour might be sensitive to the environmental and socio-economic conditions under which production takes place.

## Conclusion

No other type of aquaculture has attracted a similar level of global public attention than shrimp culture and no other type has generated so many publications in main stream and specialized scientific journals in recent years. The underlying reasons for this high publicity include well-founded concerns about the environmental and socio-economic impacts of shrimp culture and the desire to improve policies and practices through technological and regulatory advances. As with other issues which receive so much public attention, there is the danger that generalisations dominate over an appreciation of the specific ecological, socio-economic and socio-political conditions under which shrimp culture takes place. This may encourage to seek an undifferentiated global solution to problems which need to be analysed in detail and resolved by policies and measures tailored to the specific locality and region and designed and implemented with the active involvement of shrimp farmers and other interested parties.

## OVERVIEW OF LEGISLATION AND POLICIES APPLYING TO SHRIMP CULTURE

### Introduction

The present paper has been prepared on the basis of an analysis made of the legal framework for shrimp culture in a few countries. The selection of the countries has been based on the extent of documentation found in the Legal Office of FAO, its Library and Database in order to provide an inasmuch accurate picture of the situation. These countries are namely Ecuador, Honduras, Malaysia, Sri Lanka and Thailand. This documentation has also be completed with a few country papers which were readily available namely India and Sri Lanka. The analysis and country papers illustrated major observations announced in the text below.

The paper is composed of three sections: a first section attempts to highlight a few international instruments which are relevant to the subject matter while the other sections shortly analyse what is happening at national level.

### International Instruments

The purpose of this overview is not to enter into the merits of the different international instruments which may be of interest for the present subject matter but rather to provide a short insight of them. Said international instruments include:

***The Code of Conduct for Responsible Fisheries ("CCRF")*** was adopted by the Conference of FAO at its twenty-eight session in 1995. The Code is very wide in scope[1]. It is made of different articles, one of which deals exclusively with aquaculture development.[2] It includes substantive provisions relating to responsible development aquaculture, including culture-based fisheries, in both areas of national jurisdiction as well as within transboundary aquatic ecosystems; relating to the use of aquatic genetic resources for the purposes of aquaculture including culture-based fisheries; and responsible aquaculture at the production level. A few provisions focusing on legal aspects of aquaculture are of particular relevance for the present study. They encourage States to "establish, maintain and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture"[3] and further to "regulate the use of chemical inputs in aquaculture which are hazardous to human health and the environment".[4] The Code can be accompanied by its own technical guidelines. They have indeed been drafted with regard to aquaculture.[5] Yet another very relevant statement for the present subject matter is found in the article on the Integration of Fisheries into Coastal Area Management[6]. It reads: "States should ensure that an appropriate policy, legal and institutional framework is adopted to achieve the sustainable integrated use of the resources, taking into account the fragility of coastal ecosystems and the finite nature of their natural resources and the needs of coastal communities"[7]

FAO has been for many years the centre of efforts to establish a world-wide system of co-operation to control pesticides through the exchange of technical information and administrative decisions. By Resolution 10/85, the FAO Conference adopted in 1985 the ***"International Code of Conduct on the Distribution and Use of Pesticides"***. One of its primary objectives is to "set forth responsibilities and establish voluntary standards of conduct for all public and private entities engaged in or affecting the distribution and use of pesticides, particularly where there is no or an inadequate national law to regulate pesticides".[8] The Code provides for standards on pesticide management, testing, availability, use, distribution, trade, advertising, labelling, packaging, storage and disposal. It deals with activities for reducing health hazards, regulatory and technical requirements from Governments and the industry, the principles of information exchange and the prior informed consent and their respective procedures, the monitoring of the Code itself, etc.. National laws should "translate" the contents of the Code and allow for its implementation. Guidelines have been set up to this effect.[1]

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[1] In article 1, it is stated that it is "global in scope and is directed toward members and non-members of FAO, fishing entities, sub-regional, regional and global organizations, whether governmental or non governmental, and all persons concerned with the conservation of the fishery resources and management and development of fisheries, such as fishers, those engaged in processing and marketing of fish and fishery products and other users of the aquatic environment to fisheries". The same article continues to add: "It covers the capture, processing and trade of fish and fishery products, ... aquaculture, ..."

[2] Article 9 of the Code .

[3] CCRF, 9.1.1

[4] CCRF,9.4.5.

[5] FAO Technical Guidelines for Responsible Fisheries & Aquaculture Development, FAO, Rome 1997.

[6] CCRF, Article 10.

[7] CCRF, 10.1.1.

[8] Article 1.1.

Where food is concerned, standardisation (i.e. precise requirements against which product conformity can be checked) are defined and codes of practices are present. The trend referred to towards generalised standards is reflected at the national level but also at the international level in the ***Joint FAO/WHO Food Standards Programme - Codex Alimentarius Commission***. The Codex Alimentarius is a "collection of international food standards adopted by the Commission and presented in a uniform manner".[2] As such it contemplates, amongst others, provisions in respect of food additives, pesticides residues, veterinary drugs residue and for fish and fishery products, including last but not least, for the "products of aquaculture". A Draft Code of Hygienic Practice for the Products of Aquaculture has been prepared and amended/re-drafted since 1990 by the FAO Fish Utilization and Marketing Service and discussed recently at the Codex Committee on Fish and Fishery Products in Norway. The scope of this Draft Code of Practice is limited to "finfish and crustaceans produced by commercial aquaculture and intended eventually for direct human consumption. It contains general guidelines for setting up and conducting production under the most essential requirements of hygiene up to harvesting live fish and loading for transport to market. The slaughtering process is not considered."[3] It is "for information purposes and as a guideline for the elaboration of national quality standards, quality control and fish inspection regulations in countries where these, as yet, have not been developed. In addition, it could be used for training of fish farmers and employees of the aquaculture sector".[4] In other words, the implementation of the Code of Practice will have to be adapted to national and local needs, priorities and requirements.

The market access concerns that derive from a differential environmental product standards among jurisdictions have received great deal of attention in the WTO context. Of relevance to shrimp culture are ***the Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS agreement) and the Agreement on Technical Barriers to Trade (the TBT Agreement)*** adopted by the GATT members following the Uruguay Round. The basic objective of the two Agreements is to limit the use of measures (technical characteristics of products and health requirements) that do, or may, restrict trade to those that are justified to provide importing countries the level of protection that is necessary. Temporarily, nevertheless, Members maintain the fundamental right to protect themselves, at the level they determine necessary and thus to adopt and enforce appropriate environmental standards. In the SPS Agreement, full recognition is given to the important contribution that international standards, guidelines and recommendations can make with regard to the development, adoption and enforcement of sanitary and phytosanitary measures[5] and encourages the use of harmonised sanitary and phytosanitary measures between Members, on the basis of international standards, guidelines and recommendations developed by relevant international organisations including the Codex Alimentarius Commission. As far as the TBTs are concerned, the objective is to guarantee that they do not create unnecessary obstacles to, and to minimise their impact on, international trade. The latter, when introduced should be the least disruptive and temporarily. Where Codex standards exist and are relevant to the circumstances, GATT members must base their measures on them.

Both agreements dedicate a crucial role to "transparency" in the development and application of trade regulatory measures. This embraces requirements for notifying an intention to introduce such a measure at an early stage, whenever an international standard, guideline or recommendation does not exist or the content of the proposed measure is not substantially the same as the content of an international standard, guideline or recommendation, and such measure may have a significant effect on trade of other Members.[6] The incorporation of references to Codex standards and codes of practice in GATT agreements should substantially contribute to the development of international trade in food products and reduce problems emerging from differences in national legislation.[7] It should also increase co-ordination and integration between Codex and the national systems and approaches for approving food additives or for establishing tolerances for contaminants.

Besides the above instruments, a few other international agreements could be of relevance: for instance the Ramsar Convention on Wetlands of International Importance (1971) and the UNESCO Convention for the Protection of the World Cultural and Natural Heritage (Paris, 1972), both based on site protection. Both Conventions establish general obligations and performance standards, leaving it to each state party to enact and apply its own legislation according to its own needs and priorities. Neither agreement defines any type of protected area or requires adoption of any particular kind of protective measure. They have often been completed by more detailed regional texts.

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[1] For example, Guidelines for Legislation on the Control of Pesticides; Guidelines for the Registration and Control of Pesticides; Guidelines on Good Labelling Practice for Pesticides.

[2] Codex Alimentarius, general Requirements, second edition, revised 1995.

[3] Codex Alimentarius Commission, Proposed Draft Code of Hygienic Practice for the Products of Aquaculture, CX/FFP96/7.

[4] Codex Alimentarius Commission, Proposed Draft Code of Hygienic Practice for the Products of Aquaculture, CX/FFP 96/7.

[5] See definition in the Agreement on the Application of Sanitary and Phytosanitary measures, in annex.

[6] Annex B of the SPS Agreement.

[7] R.J. Ronk and D. Dodgen, "Food Standards: an overall strategy for common requirements applicable to all foods", FAO/WHO Conference on Food Standards, Chemicals in Food and Food Trade, ALICOM 91/6.

## National Policies

Government policies in relation to shrimp culture have played and are playing a major role in the development of the shrimp culture industry. They concentrated largely on providing financial and technical support to the shrimp industry. This has been particularly the case in *India, Sri Lanka and Thailand*. Objectives pursued were initially the development and promotion of the industry and increase of foreign exchange earnings and lately promotion of sustainable and environment friendly shrimp culture. Financial incentives to promote and develop the industry included primarily loan facilities for the development of the industry, tax exemptions for the import of the externalities (feed, seed, laboratory equipment, etc.) as well as favourable access conditions for private and foreign investments. With emerging social and environmental changes, financial incentives have moved towards the provision of government subsidies for the introduction of "green equipment" and technical support has been introduced. It focused on the provision of extension services with the view of decreasing shrimp diseases, improving the production (quality and quantity) as well as developing sustainable environment friendly shrimp culture. Faced with social and environmental costs, some countries, like *Thailand,* gave considerable attention to the provision of technical support to the medium size and small scale farmers. This led to close consultation and collaboration between the Government and the farmers in the implementation of government policies. It appeared that where a Government did not consider the value of country's social environment, social conflicts and ecological problems increased. Actions yielded an unsustainable investment. Besides this support, Governments introduced land lease policies with the view of facilitating the access to coastal areas *(India),* of protecting of mangrove areas *(Ecuador)* and of organising the allocation of coastal resources *(Sri Lanka, Ecuador, Thailand)*. As means to site shrimp farms, zoning techniques were provided for.

## National Legislation

Regulatory frameworks for the development of aquaculture in general, shrimp culture in particular, is legally and institutionally complex. Shrimp culture occurs in coastal areas where issues are complex and all concerns legitimate. Typically, it involves legislation which addresses a variety of issues such as land use planning and tenure, water quality, fish movement and disease, pharmaceutical use, food quality and public health. Typically, it concerns various institutions competent in these subject matters. Hence there appear to be more laws than there are effective enforcement mechanisms.

***Facts which raise legal issues with regard to shrimp culture development and management include the following:***

- shrimp culture involves the production from most often publicly regulated resources i.e. water, irrespective whether marine or fresh, coastal lands, foreshore, wetlands, mangroves, etc. They usually belong to the Government (public domain);
- shrimp culture products need to be ready for human consumption (domestic and international market);
- a balance needs to be found between the continuous productive operation of a shrimp farm and the conservation of the natural resources;
- shrimp culture is dependent on water and soil quality and quantity and thus vulnerable to changes caused by other users of the same resources as well as likely to alterate those shared resources;
- shrimp culture occurs on high value resources (coastal resources) which are most often intensively used by human beings and thus subject to competing uses.

Laws and regulations covering specifically shrimp culture are not very frequent. Primary aim of existing regulations concerning shrimp culture respond to the need to protect the development of the activity (e.g. to regulate its access or stimulate investment), to deal with a few management aspects (water quality treatment) and with specific threats of environmental pollution and degradation which are affecting and/or caused by the development and conduct of shrimp culture activities (e.g. the destruction of mangroves).

In the countries which have been under review the following ***measures were found***:

1. preventive measures: authorisation techniques (*Ecuador, Honduras, Sri Lanka (unified system), India, Malaysia (two tier system), , Thailand*)[1], EIA procedures (*Sri Lanka, India, Honduras*), zoning (*Ecuador, Sri Lanka, India, Thailand*), listing of restricted or prohibited activities as well as standard setting in relation to development and management aspects (*Ecuador, Sri Lanka, Thailand*); rules do not apply invariably to all shrimp farms: often shrimp farms are classified on the basis of the production/ha/year (*India*[2])or on the size of the farm (*Malaysia);* accordingly, different terms and conditions are set; an essential condition of initial and continuing authorisation is compliance with certain environmental standards *(Thailand);* the zoning is often the result of an integrated environmental protection of the coastal area based primarily on regulation of determined human activities and the planning for the use of space and not on the use of specific substances.

2. economic incentives for environmental protection: effluent charges (*Sri Lanka*), tax incentives (*Ecuador, Honduras*, *Sri Lanka*), deposit schemes (*India: TamilNadu the Eco-fund*), user charges (*Thailand*), etc.; All of them in one way or another, aim explicitly at ensuring environment friendly installations either during the construction phase or after termination of activity; Bank-lending policies were found in *India and Sri Lanka.* These contributed significantly to the development of shrimp culture but did not include environmental behaviour as a factor in assessing the credit-worthiness of the concern. However, recently, in *Sri Lanka,* special lending facilities have been made available to provide shrimp farms with water treatment systems, recirculation systems. Of relevance in this country is also the "eco-duty" imposed on each kilo of shrimp exported to reimburse the Government "environment expenditures".

3. with some exceptions for *Thailand* and *Malaysia (Kedah State*), no countries have centralised their surveillance, monitoring and assessment in a single government agency, nor rely on a special aquaculture network of decentralised institutions co-ordinated by a national institution or agency, nor prescribed a self control by farmers. General reliance has been put on un-co-ordinated sectoral state surveillance, monitoring and assessment and on voluntary control by farmers;

4. enforcement actions include civil actions (*Malaysia*), administrative remedies, such as fines, refusal, suspension, revocation (*Honduras, Ecuador, Sri Lanka*) and criminal prosecution (*Malaysia*).; Environmental laws in general often may permit agencies to impose fines on violators. They can be both individual and corporate, and are substantially increased for repeated misconduct. Increasingly, in countries reviewed, national law is imposing criminal liability on those who pollute and perform other acts damaging the environment (e.g. offences in case a person causes or knowingly permits any poisonous, noxious or polluting matter to enter in coastal waters).

5. codes of practices: the concept in aquaculture is rather new. They aim at offering guidance for the establishment and conduct of environment friendly aquaculture operations (*India, Sri Lanka*). The scope is limited to a specific aquaculture system (*India*)[3] though it happens that codes cover aquaculture developments in general (*Sri Lanka*). In both cases they were issued by a state authority.

Existing laws and regulations in many countries which affect directly or indirectly shrimp culture development could constitute an appropriate starting point for the purposes of managing the development of these activities and, in particular to regulate the access, deal with users' conflicts and protect the environment. However, they are not always fully made use of due to inadequate institutional support for effective and co-ordinated implementation. Often proper enforcement is missing. There may be a need to codify disparate rules rather than drafting new rules. On the other hand in some cases, improving enforcement may require new legislation and institutional reform.

### *Elements hampering effectiveness of institutional choices and laws and regulations*

There are different legal factors and institutional choices which may hamper the effectiveness of policies and legislation and which may constitute an obstacle for policies and legislation to reach the desired results. One cannot point solely to poor design, lack of resources, inadequate public consultation, inappropriate training, opportunistic behaviour, or overly centralised institutions as the only sources of the problem, even though some of these factors are most likely involved whenever a policy or a law does not reach expected results.

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[1] among the countries under review, most of them have a general licensing system for aquaculture whatever species are intended to be cultivated, whatever objective is followed, whatever system is used, whatever production is envisaged.

[2] In **India**, whereas the **Tamil Nadu** Aquaculture (Regulation), 1995 applies to all "coastal aquaculture units", the Government Guidelines for Sustainable Development and Management of Brackishwater Aquaculture operate a distinction between extensive brackish aquaculture (i.e. max. 2 tonnes/ha/yr) and semi-intensive and intensive culture (i.e. 5 tonnes/ha/yr - 2 crops) for the purposes of implementing the Government Guidelines for Sustainable Development and Management of Brackish Water Aquaculture. 1995

[3] The **Indian Guidelines** referred to above are expected to be "useful in formulating appropriate shrimp farming management practices and adopting measures for mitigating the environmental impact for management of shrimp pond wastes and utilisation of the land/water resources in a judicious manner". The management practices and norms to be adopted by the shrimp farmers and the authorities are indicated contemporarily.

Policies have often been designed in a reactive manner rather than proactively. As a consequence measures hastily in response to urgent problems, and thus the authorities may overlook the impact on people and circumstances of the proposed new policies and rules and their practicality.

From a more legal point of view, aquaculture, including shrimp culture is often covered in the basic fisheries legislation whereas it might deserve a specific set of rules: there is a necessity to raise the awareness of the differences between aquaculture and capture fisheries. This may result in difficulties to classify this activity. This ambiguity is not necessarily bad but can be troublesome when implementating of laws and regulations. Rules applicable to aquaculture may not always have been drafted with aquaculture in mind. Typically, few pesticides have been registered for the use in aquaculture whereas they may have been registered for other uses. Finally, despite the raising awareness of the cross-sectoral impacts of shrimpculture projects, the institutional framework is still strongly characterised by a sectoral approach and the control of shrimp culture has not always an institutional identity. Hence the enforcement decisions may not be the most adequate.

## Conclusions

Proposed policies as well as the laws and regulations which most often implement them need to achieve their purposes. This implies that consideration be given:

- to the nature of the problem;
- to the purposes of proposed policy and legislation: spirit and intent;
- to the means by which those purposes have to be achieved: how will the scheme work, practicality of the proposed machinery;
- to the impact of proposals on existing circumstances and other existing policies and laws.

Experience confirms the widespread existence of an illusion that to legislate in respect of a problem is of itself in some way to meet that problem, as if legislation amounted in some mystical way to action instead of amounting only to a legal framework for action. Governments may be pushed in tasking rapid legislation while forgetting to take into consideration the capacity of the proposed legislation to be administered effectively and equitably.

However, the complexity of the problems might make it difficult to incorporate all issues raised by shrimp culture in a single text. Hence this may constitute a reason for considering the use of codes for regulating shrimp culture. They offer also the advantage of being more flexible and readily “amendable”. Rules originally conceived as guidelines or recommendations can have an impressive “juridical career” in that they may develop in a short time to binding rules. This may happen because the recommendations or guidelines are shared by the overwhelming majority of those concerned by them.

## WORKING GROUP A

## LEGAL, INSTITUTIONAL AND CONSULTATIVE FRAMEWORKS FOR SHRIMP CULTURE DEVELOPMENT AND MANAGEMENT

## DISCUSSION GUIDE

### Background

A legal framework governing aquaculture must be based on sound interdisciplinary knowledge, be sufficiently flexible to account for dynamic changes in the environment and of socio-economic conditions, and, perhaps paradoxically, have a long-term orientation.

Such framework should contribute to maintaining the ecological balance in an unseen future and, in particular address the potential threat of irreversibility of impacts. Legislators need to accept the fact that environmental harm can be permanent, as is the case, for example, with the extinction of species from the wild. This leads to the need to focus on preventive measures taking into account the inherent uncertainties rather than traditional legal remedies for breach of law.

There is awareness that the present legal, institutional and consultative arrangements are in many situations not conducive to promote shrimp culture development in a sustainable manner.

Some of the deficiencies of existing legal and institutional arrangements include the following:

- the integration of aquaculture including shrimp culture in basic fisheries laws;
- the absence of legislation covering coastal shrimp culture either specifically or within a legal framework relating to coastal development in general;
- inadequate legislation on land use, in particular State land in coastal areas;
- absence of satisfactory legal and institutional arrangements to govern the use of other common property resources that serve as inputs into shrimp culture, in particular fresh water drawn from coastal aquifers and post larvae collected from the wild;
- deficient or unenforced legislation on the use of chemicals in shrimp culture and on the treatment of effluents from shrimp farms;
- conflictual and overlapping competencies of government institutions due to a dispersion and variety of environmental regulations and administrative weaknesses with respect to control and monitoring of coastal activities, including shrimp culture activities;
- absence of mandatory procedures for coastal development planning and for related consultative mechanisms among various government agencies competent with respect to shrimp culture and with resource users and coastal communities in general.

Shortcomings in legal regimes are not always the sole or even primary reason why coastal shrimp culture expansion has been chaotic at times and faced with various well-known problems. The unawareness of and the inadequate implementation and enforcement of available laws and regulations including environmental ones are often contributing factors if not the primary reason for unsustainable practices. Governments at national, provincial and local levels face various institutional weaknesses that impede effective law enforcement in general and not solely related to shrimp culture. An adequate legal basis is, therefore, a necessary condition to achieve sustainable practices but it is by no means a sufficient condition. While law enforcement is needed based on compliance control by the proper authorities and on legal prosecution and sanctioning of trespasses, the potential role should not be underestimated of traditional means of compliance control and punishment through peer pressure and ostracism. Traditional systems might be especially important in situations where shrimp culture is conducted in a small-scale fashion by large number of farmers whose activities might be difficult to control exclusively through formal law enforcement procedures.

Law enforcement through both modern and traditional means is believed to be greatly facilitated if there is sufficient awareness about the rationale behind the different regulatory measures and the immediate and long term benefits to be realised by rule compliance. Extension services, awareness campaigns and other educational activities are likely to be required in most situations. These will also contribute to an informed process of consultation among the various interested parties in shrimp culture and coastal development.

Expected Outcomes

There are three kinds of outcomes expected from the deliberations of the Working Group (WG):

1. Guiding principles for legal, institutional and consultative frameworks for shrimp culture development and management.

2. The section of the draft annotated outline of the envisaged guidelines on policies for sustainable shrimp culture which addresses legal, institutional and consultative arrangements.

3. Suggestions for the kind of follow-up needed to (a) produce this section of the guidelines and (b) promote their dissemination and effective application.

Guiding principles may relate to the following points:

- the development and management aspects of shrimp culture which should be covered by specific laws and regulations; in other words, the circumstances and problems which legislative proposals should meet, primary purposes and primary target groups of such legislation;

- effective enforcement may refer to: traditional means (peer pressure, social outcasting), command and control (fines, prison sentences), administrative decisions (closure of an establishment), monetary compensation to those harmed by the environment, fiscal measures (tax reductions for manufacture, sale and use of ecologically sound products or imposition of surcharges on products and processes that harm the environment), ecological loans, eco-funds;

- the administrative levels (i.e. national, provincial or local) at which legislative authority should be based for different development and management aspects; special responsibility areas;

- the kinds of consultative mechanisms needed at different administrative levels and the means required to ensure that informed decision-making processes can take place; when and the extent to which consultation(s) have to take place within and outside the various government agencies; the roles of traditional decision-making structures at the local level;

- the procedures to be followed and consultative mechanisms required in securing co-ordination with regard to the implementation and enforcement of laws and regulations; conflict resolution solutions between different government bodies;

- cost coverage of the legal, institutional and consultative arrangements.

With regard to the envisaged guidelines, the WG may first consider who should be the target group(s) and if different sets of guidelines are needed for different target groups. With respect to legal aspects, the WG may discuss the potential usefulness of developing a model legislation for coastal shrimp culture and the areas to be covered.

In view of the fact that many countries are in the process of , or envisaging, specific legal and institutional arrangements for integrated coastal management, the WG may consider how the specific requirements of coastal shrimp culture could best be accommodated therein. Similarly, the WG may deliberate the specific requirements of environmental impact assessment (EIA) procedures vis-à-vis shrimp culture development, keeping in mind the problem of aggregated impacts of shrimp farms whose environmental effects when individually assessed may stay within prescribed standards. The WG may also consider the kinds of economic, social and nutritional impacts at household, community and regional levels which may be made subject to formal assessment procedures.

The WG may discuss measures which could be taken to promote and facilitate self-regulatory management regimes among, especially small-scale, shrimp farmers including their organisation into groups or associations and the roles of government and/or private extension and training services.

Concerning institutional aspects, the WG may discuss the specific functions fisheries departments should fulfil such as interdepartmental co-ordination, planning, licensing, monitoring and surveillance and monitoring, etc.).

As regards the production of the guidelines, the WG may suggest the kinds of collaborators which FAO should associate with this task and the kind of review process they should be subjected to prior to their finalization and publication. The WG may also advise on the time frame for this task.

Finally, the WG may consider the roles and means of the various actors (e.g. governments, industry, farmers and their associations, and regional and international organizations including FAO) in promoting and facilitating the adoption of the guidelines.

## WORKING GROUP B

## PLANNING AND REGULATORY METHODS AND TOOLS AND ECONOMIC INCENTIVE SCHEMES FOR SHRIMP CULTURE DEVELOPMENT AND MANAGEMENT

### DISCUSSION GUIDE

### Background

There is general awareness of the indispensable role of government intervention at various levels to ensure that shrimp culture development takes place in a sustainable and responsible manner. There is also an increasing understanding about the need for cooperation by shrimp farmers and firms in planning and regulation and about the potential for self-regulatory measures by them. Similarly, the interests of other economic sectors of the coastal areas where shrimp culture takes place need to be taken into account to ensure well-integrated development.

Shrimp culture takes place under varying environmental, economic, social and political conditions and, thus, there is no uniquely best planning and regulatory system. Moreover, the scale and technology of shrimp farming and the economic conditions of shrimp farmers differ significantly. These variations may reflect on the detailed interpretation of what is meant by ‘sustainable shrimp farming’ in a specific geographic area.

In spite of the variability of how, where and under what conditions shrimp culture takes place, there is general agreement about the specific management issues which need to be addressed. The first, and possibly most important, consideration is the siting of ponds and related infrastructure facilities. Existing land use planning by governments may not apply to the localities where shrimp farming takes place or may not distinguish between shrimp culture and other agricultural activities such as rice cultivation. As a consequence, land use and siting decisions may be primarily governed by the short term economic incentives faced by private investors including small-scale farmers who decide to switch land use in response to relative profitability.

A second set of management issues relates to other production inputs in addition to land, i.e. seed, feed, freshwater, saltwater and pharmaceutical and other chemicals. The common nature of the management problem related to these inputs is that their use often causes impacts beyond the confines of the production unit where the decision is taken of how much, when and what specific type of input is used. Such external effects can have far-reaching economic, social and environmental repercussions on other shrimp farms, agricultural farms, other users of the marine environment (e.g. tourism), coastal communities, and others. An important kind of policy response to externalities advocated by economists but which is also reflected in, for example, the 1992 Rio Declaration on Environment and Development, is to attempt to internalise environmental costs through the polluter’s pay principle.

In spite of the broad agreement with the polluter’s pay principle, in actual practice, regulatory standards are much more widely applied in addressing externalities. In shrimp culture, standards might be established concerning the source of seed and how it is produced, the maximum stocking density in different environments; the composition and amount of application of feed under various conditions and intensities of culture; the way how fresh water and saltwater is procured and water quality standards for their release back into the environment; and the kinds and doses of chemicals which can be applied in various natural conditions and farming systems. There are considerable difficulties in defining widely applicable production standards because of the diversity of conditions, rapid technological change, and the fact that desirable standards are not invariant to the number of farms in a certain locality. Moreover, the setting of standards cannot be seen in isolation of the actual capacity and capability of, on one hand, the farmers to adhere to them, and, on the other hand, for the regulatory authority(ies) to enforce compliance through adequate monitoring and, if need be, prosecution and sanctioning of trespasses.

Both the application of the polluter’s pay principle and the setting of standards will impose extra costs on the individual shrimp farmer and on government administrations. A priori, it is not, however, definite that such additional costs will outweigh the benefits which can be obtained by farmers and the government through these policy responses. The benefit to government is, in addition to fees/taxes received from applying the polluter’s pay principle, the higher tax incomes realized from sustained profits and incomes by farmers (say through an export tax) as well as a potential reduction in debt repayment on foreign loans. In the case of shrimp farmers, the benefit from sustained production and its marketability is evident.

Expected Outcomes

There are three kinds of outcomes expected from the deliberations of the Working Group (WG):

1. Guiding principles for planning and regulatory methods including economic incentives applied to shrimp culture.

2. The section of the draft annotated outline of the envisaged guidelines on policies for sustainable shrimp culture which addresses planning and regulatory methods and economic incentives.

3. Suggestions for the kind of follow-up needed to (a) produce this section of the guidelines and (b) promote their dissemination and effective application.

Keeping in mind the wide diversity in the ecological, economic, social and cultural contexts in which shrimp culture takes place, the WG should elaborate specifically on the following points:

- the principle(s) to be followed in the siting of shrimp farms and the relative merits of regulatory policy measures including the designation of off-limit zones for shrimp farming, a process of permitting based on specific conditions and consultative mechanisms, activity-specific land use taxes/charges in those instances where the land market fails to convey the full economic value of land, and others at the discretion of the WG;

- the scope and modality of applying the polluter's pay principle and possible alternatives when and where its application may be inappropriate or the same result could be attained more effectively through other policy responses such as regulatory standards;

- the scope for establishing widely applicable standards for production inputs and outputs and the process(es) through which such standards could be produced and kept up to date;

- the kinds of standards which might be needed at the level of the local or regional ecosystem(s) and administrative unit(s) and the principles which might be followed in their establishment and up dating;

- the kind of mechanisms which would be required to ensure that standards are being complied with;

- the measures which might be needed to facilitate the adoption of the polluter's pay principle and/or of standards, considering the constraints faced by governments and farmers vis-à-vis human resources, finance, access to technology, and others.

At its discretion and time permitting, the WG may discuss additional points deemed important.

As regards the production of the guidelines, the WG may suggest the kinds of collaborators which FAO should associate with this task and the kind of review process they should be subjected to prior to their finalization and publication. The WG may also advise on the time frame for this task.

Finally, the WG may consider the roles and means of the various actors (e.g. governments, industry, farmers and their associations, and regional and international organizations including FAO) in promoting and facilitating the adoption of the guidelines.

# WORKING GROUP C

## THE POTENTIAL ROLE AND CONTENTS OF A VOLUNTARY CODE OF CONDUCT FOR SUSTAINABLE SHRIMP CULTURE

## DISCUSSION GUIDE

### Background

Codes of conduct and codes of good practices are increasingly being developed and applied nationally and internationally to bring about desirable and predictable behaviour by decision-makers in the private and public sectors. Codes can be the first step in the introduction of internationally agreed standards or other legal instruments. Voluntary codes to be implemented by industry may have a significant role in reducing the need for costly government regulatory interventions through, for example, command and control measures. The reassurance of consumers and intermediaries such as wholesalers and retailers about the absence of adverse environmental impacts and respect of human rights and labour standards when producing a product is known to have the potential of increasing demand for such products in international and national markets.

A code of conduct or a code of good practices can be effective if governments, industry and other interested parties such as consumers feel committed to its objectives and have the will and means for its actual application or implementation. A central function of a code is to coordinate the behaviour or policies of decision-making units such as individual farmers, cooperatives or governments. By agreeing to behave in a specified manner, common problems can be resolved such as, for example, maintaining water quality within common water bodies used by several farmers. If each farmer attempts, for example, to minimize water treatment costs and thus discharges untreated effluents in the common water body, water quality is likely to progressively deteriorate and all farmers will suffer economically from production losses through sub-optimal growth and disease outbreaks.

A code can also reassure consumers that certain negative attributes which have been associated with a certain kind of product do not apply to those purchased from producers or retailers who adhere to its provisions.

### Expected Outcomes

The Working Group (WG) may first examine the scope, and possible opportunities and limitations, of the provisions of Article 9 "Aquaculture Development" of the Code of Conduct for Responsible Fisheries (CCRF) when applied to shrimp culture. These provisions as well as most others of the CCRF are addressed to States rather than industries or consumers. The WG could take the view that due application by States of the aquaculture provisions of the CCRF to coastal shrimp culture could adequately cover the desirable role of States and governments.

On the other hand, the WG may conclude that in addition to Article 9 of the CCRF, there is a need to elaborate a supplementary code which should specifically govern the behaviour and practices of shrimp producers, and possibly also of others such as producers of feed, seed, chemicals etc., shrimp processors, wholesalers and retailers, environmental groups, consumer organizations and others. In this respect, the following **general issues and questions** arise:

What should be the principal objectives of a supplementary code and which issues should be addressed by it? In this regard, the WG may wish to differentiate between the establishment of new shrimp farms and already operational farms.

What should be the roles and responsibilities of producers (farmers/farm owners), suppliers of inputs (manufacturers/suppliers of seed, feed/fertilizers, chemicals, equipment, etc.), and companies/people involved in shrimp processing, distributing and marketing (including exporters, importers, retailers, supermarket and restaurant chains) and of shrimp consumers?

How can geographical, social, economic and other differences be reflected in the code?

How will the code address externalities (e.g. water pollution) inflicted upon the shrimp culture sector by other sectors?

Should the code be applicable globally, to all regions and states; or should it be developed at the regional level, taking into account particular situations of each region?

How should the code be developed, which groups should participate in its elaboration and what would be a reasonable time frame for its development?

Who will bear the costs of developing and implementing such a code ? Acceptance of such a code may be enhanced through measures and means to facilitate or accelerate implementation.
Who should monitor the adoption of and compliance with the provisions of such a code?
How should the code be evaluated for its effectiveness and flexibility for adjustments to address new issues.
What should be the relationship of such a code to the CCRF?

The WG may further deliberate if there are aspects of shrimp culture which should not be left to a voluntary code but be made subject to more formal systems of regulation. The WG may also discuss which conditions in a region or country may favour the effectiveness of a code and how such could contribute to influencing such conditions in a positive manner.

The time and funds required for the development of a supplementary code or other instruments and their **practical applicability** have to be carefully assessed. Regarding the latter, several issues may deserve special attention by the WG:

Technical difficulties and economic costs related to the establishment and monitoring of desired environmental, economic and social criteria or standards of sustainability and costs of implementation of such assessments;
The special requirements of developing countries in terms of financial and human resources and institutional capacities for implementing a code or other instruments (on this point, see Article 5 of the CCRF).
Particular implementation difficulties are expected in situations where there are large numbers of small-scale farmers involved in shrimp farming, as is the case in many parts of Asia. The WG may wish to consider measures which would facilitate the implementation of a code or other instruments by small-scale shrimp farmers including educational and extension programmes, and possibly also provision of funds.

The WG should advise if the envisaged guidelines on policies for sustainable shrimp culture should refer to the need, and requirements, for the establishment and implementation of a special code of conduct or other instruments for shrimp culture. If affirmative, the WG should advise how sections of the code or other instruments should be produced.

Alternatively (or complementarily), the WG may wish to advise on the role which the FAO Secretariat may take, subject to the availability of funds, in the development of such a specific code or other instruments for shrimp culture.

# DOCUMENTOS PRESENTADOS POR

# LA SECRETARÍA DE LA FAO

## NOTA INFORMATIVA

### Antecedentes

Hay pocas actividades económicas que han alcanzado a nivel mundial durante el último decenio tasas de crecimiento tan altas como las del cultivo del camarón en zonas costeras. Este rápido desarrollo ha ido acompañado de controversias cada vez mayores sobre el impacto ambiental, social y económico de dicho cultivo. Hay una notable incertidumbre sobre las respuestas apropiadas en materia de política y ordenación, sobre todo porque se reconoce que el cultivo del camarón produce notables beneficios en las regiones costeras y a nivel nacional.

Entre las causas de los elevados índices de crecimiento cabe señalar el progreso tecnológico y la alta demanda de mercado, especialmente en Japón, EE.UU. y Europa, así como el estancamiento o la reducción de los suministros procedentes de poblaciones de camarones silvestres, muchas de las cuales se hallan sobreexplotadas. Las elevadas tasas de crecimiento han sido posibles también gracias a dos factores: en primer lugar, muchos gobiernos, ayudados frecuentemente por organismos donantes bilaterales y multilaterales, han apoyado activamente el desarrollo del cultivo del camarón orientado a la exportación con el fin de ganar divisas. Este apoyo ha adoptado formas diversas, desde la provisión de créditos subvencionados hasta planes de extensión y capacitación patrocinados por el gobierno. En segundo lugar, se han realizado de forma acelerada las actividades de planificación, en los casos que existían estas actividades, y la concesión de permisos para el emplazamiento y operación de las granjas productoras de camarón en las zonas costeras. De esta forma, en el origen de las impresionantes tasas de crecimiento del cultivo del camarón se hallan los incentivos económicos creados por elevados rendimientos de la inversión o la expectativa de los mismos y la rapidez con que se han podido establecer las nuevas granjas. Aunque es posible considerar estas condiciones como signos saludables del desarrollo económico, hay pruebas de que la planificación y los marcos reglamentarios gubernamentales han sido en varios casos insuficientes para garantizar la sostenibilidad de los beneficios privados del cultivo del camarón y para conseguir plenamente los beneficios sociales previstos.

A falta de reglamentos eficaces y/o de cambios en los incentivos económicos mediante políticas fiscales (por ejemplo, impuestos, derechos, etc.), de cupos comercializables u otras medidas, el cultivo del camarón está expuesto en general a problemas de disfunción del mercado en la asignación de recursos escasos. Normalmente no hay mercados eficaces para importantes insumos de producción, o son insuficientes, especialmente los relativos a recursos de tierras, agua dulce y ambientes específicos valiosos, como los manglares. La disfunción del mercado se debe también a externalidades relacionadas con la descarga de efluentes sin tratar en el medio acuático que utilizan en común distintas granjas vecinas para renovar el agua de sus estanques. El empeoramiento de la calidad del agua reduce la tasa de crecimiento y la resistencia de los animales a las enfermedades, y puede contribuir directamente a la propagación de la contaminación viral. La consecuencia de estos tipos de disfunción del mercado es que los empresarios reciben señales de precios erróneas con respecto a los costos reales de producción, por lo que no adoptan las decisiones óptimas sobre la tecnología e intensidad de producción, el emplazamiento de los estanques y las medidas de tratamiento de los residuos.

La disfunción del mercado suele influir también en la forma en que distintas personas participan en los beneficios y costos de una actividad económica. En algunos casos, el cultivo del camarón no ha beneficiado directamente a las comunidades locales, sino que ha impedido el acceso tradicional de la gente a recursos de propiedad común y ha reducido la disponibilidad de los mismos a causa de su agotamiento y degradación. Ejemplo típico es la extracción excesiva de recursos de aguas freáticas de las acuíferas costeras, que ha provocado el descenso de la capa freática y la intrusión de agua salada, lo que ha afectado a los suministros de agua dulce de las comunidades costeras. Este y otros efectos negativos del cultivo del camarón en las comunidades y ambientes costeros ha sido en muchos casos la causa de graves conflictos sociales que en los últimos años han desacreditado esta actividad a los ojos de muchas organizaciones no gubernamentales locales, nacionales e internacionales. La actitud negativa de estas organizaciones contrasta con las ideas de los responsables de las políticas, planificadores y otras personas que señalan los muchos beneficiarios del cultivo del camarón, incluidos pequeños agricultores, y el gran número de personas, frecuentemente de bajos ingresos, que se hallan empleadas en la recolección de semillas, procesamiento del camarón y otras actividades auxiliares.

### Objetivo

El objetivo de la Consulta Técnica es contribuir a la preparación de directrices que contengan opciones de política y metodologías para que los responsables de las políticas gubernamentales y, especialmente los planificadores, desarrollen una estructura de incentivos y un marco reglamentario y de adopción de decisiones adecuados para el fomento del cultivo sostenible del camarón. Las directrices apoyarán la aplicación del Código de Conducta para la Pesca Responsable, especialmente las disposiciones pertinentes incluidas en su Artículo 9 "Desarrollo de la acuicultura", y podrán facilitar la elaboración de planes de autorreglamentación voluntaria que puedan aplicar los grupos de productores o las asociaciones industriales.

## Ambito de aplicación

La Consulta constituirá un foro para el debate de los siguientes aspectos del desarrollo del cultivo del camarón en zonas costeras: 1) marco legal e institucional para la planificación, reglamentación, seguimiento y cumplimiento de las normas; 2) métodos de planificación y reglamentación (por ejemplo, planificación integrada; técnicas de valoración de recursos; incentivos/desincentivos económicos; derechos comercializables; reglamentos directos); 3) medidas de política que afectan a la distribución de los beneficios netos del cultivo del camarón; 4) determinación de los aspectos de ubicación y de gestión de la granja que exigen el establecimiento y la aplicación de normas de producción; y 5) medidas para alcanzar un consenso y resolver los conflictos, con inclusión de métodos de planificación participativa y acuerdos de arbitraje y solución de controversias. Se reservará una parte del tiempo de la Consulta al examen del tipo de actividades de seguimiento que debería realizar la FAO.

## Documentación

Entre los documentos para la Consulta Técnica se incluyen las aportaciones escritas de las personas e instituciones participantes y una guía detallada de los debates preparada por la FAO. Las contribuciones escritas incluirán un resumen de importantes publicaciones precedentes sobre este tema; estudios de casos sobre el impacto económico, social y ambiental del cultivo del camarón en zonas costeras y sus beneficios macroeconómicos; estudios de casos de métodos de planificación y medidas de reglamentación aplicados por los gobiernos. Y un examen de algunas legislaciones nacionales pertinentes al cultivo del camarón en las zonas costeras.

## Organizaciones colaboradoras

La FAO organiza y financia parcialmente la Consulta. Hasta el final de julio de 1997, habían acordado apoyar técnicamente la Consulta las siguientes organizaciones: INFOFISH (Organización Intergubernamental de Información y Asesoramiento Técnico para la Comercialización de Productos Pesqueros en la región de Asia y el Pacífico); NACA (Red de Centros de Acuicultura de Asia y el Pacífico); y SEAFDEC (Centro de Desarrollo de la Pesca en Asia Sudoriental). Ha indicado la posibilidad de prestar apoyo el Departamento del Medio Ambiente del Banco Mundial. Se invitará a gobiernos, organizaciones no gubernamentales y a la industria privada a que aporten a la Consulta su contribución técnica y financiera.

## Resultados

Los principales resultados previstos de la Consulta Técnica consisten en el asesoramiento detallado acerca del contenido y las formas de distribución de las directrices sobre políticas para el cultivo sostenible del camarón que se prepararán después de la Consulta, así como acerca de los grupos a que se destinan.

## Participantes y celebración de la Consulta

Los participantes (unos 50) en la Consulta serán funcionarios gubernamentales y académicos/investigadores que se ocupan de la acuicultura, la planificación y la ordenación ambiental en distintas disciplinas, tales como la economía, la biología y la legislación; personal de organismos multilaterales y organizaciones no gubernamentales que representan distintos intereses, como la industria, el medio ambiente y el desarrollo. La Consulta se celebrará durante 4 días del 8 al 11 de diciembre de 1997, en la Oficina Regional de la FAO para Asia y el Pacífico (RAP), Maliwan Mansion, 39 PHRA Atit Road, Bangkok 10200, Thailandia.

## Secretaría Técnica

El Departamento de Pesca de la FAO ha nombrado Secretario Técnico de esta Consulta al Sr. Rolf Willmann, de la Dirección de Políticas y Planificación Pesqueras. Su dirección en la FAO es:

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# PANORAMA RESUMIDO DE LA LITERATURA SOBRE EL CULTIVO DEL CAMARÓN

## Introducción

Con este panorama resumido se trata de ofrecer una breve relación de las principales tendencias observadas en la literatura sobre el cultivo del camarón durante los últimos decenios. Su objetivo es determinar importantes lagunas en nuestros conocimientos sobre este sector a fin de orientar mejor los futuros esfuerzos de investigación para mejorar las políticas y prácticas de ordenación. Sin embargo, no se pretende que sea completa su cobertura de más de 600 referencias compiladas mediante una reseña de la literatura reciente[1].

## Tendencias principales

Durante los dos últimos decenios se han desarrollado tipos modernos de cultivo del camarón en estanques costeros, cuya expansión se produjo durante el último decenio. Gran parte de la literatura en los primeros años desde el comienzo del cultivo moderno del camarón se dedicó a distintos tipos de problemas tecnológicos relacionados con la proyectación del estanque y la granja, la composición y dosis de los piensos, el suministro de semillas, la intensidad de la repoblación y otros. En este período, los determinantes decisivos de los costos de producción eran los costos de inversión inicial en la construcción de los estanques, los canales de entrada y salida del agua, los diques, las carreteras de acceso y otra infraestructura auxiliar. Los costos de operaciones se mantenían bajos mediante la utilización de las mareas lo que obligaba a situar los estanques en zonas bajas cerca de la costa. Frecuentemente, estas zonas eran manglares que ya se habían utilizado en parte con carácter estacional para sistemas tradicionales de cultivo mixto de camarón y peces. Este hecho dio lugar desde comienzos de los años ochenta a los primeros síntomas de preocupación por la eliminación de manglares mediante el cultivo del camarón. Esta preocupación se basaba en motivos ecológicos y socioeconómicos con respecto al hábitat, la protección de la línea costera y otras funciones ecológicas valiosas de los manglares y con respecto a sus usos múltiples por las poblaciones rurales primarias que derivaban importantes beneficios de subsistencia de estos ecosistemas altamente productivos. La experiencia adquirida en esos años con los problemas relacionados con la acidificación del suelo condujo, al menos a mediados de los años 80, a la aceptación de la opinión de que las zonas de manglares no suelen ofrecer las condiciones óptimas para los tipos modernos de cultivo del camarón en estanques. A raíz de ello disminuyó la tasa de utilización de manglares para el cultivo del camarón, pero no se dejó totalmente de construir los estanques de camarón en dichas zonas por distintas razones, entre las que figuran las dificultades con que se enfrentaban los gobiernos para hacer cumplir efectivamente la legislación sobre protección de manglares.

En algunos países (p.e. Tailandia), se han hecho en los últimos años estimaciones detalladas para cuantificar la medida de las pérdidas de manglares relacionadas con el cultivo del camarón. Tales estudios confirman la notable reducción de la conversión de manglares para el cultivo en estanques. Se han hecho pocos estudios para tratar de valorar en términos económicos y sociales las pérdidas relacionadas con la eliminación de manglares. Sigue habiendo notables lagunas en los conocimientos sobre la cuantificación, por ejemplo, de las pérdidas en la abundancia de poblaciones de peces y crustáceos silvestres que pueden atribuirse a la reducción de los manglares. Esta tarea resulta difícil sobre todo a causa del impacto frecuentemente fuerte que una pesca de captura marina excesivamente capitalizada ejerce en las mismas poblaciones, así como a la gran variabilidad relacionada con el clima en el reclutamiento de estas especies. De igual forma han resultado difíciles de cuantificar los beneficios de protección costera de los bosques de manglares. Por otra parte, la mayor preocupación por la conservación de la diversidad biológica, codificada internacionalmente en el Convenio sobre la Diversidad Biológica, coloca a la mayoría o la totalidad de los ecosistemas de manglares en el rango de zonas prioritarias para la protección y para modalidades múltiples de uso dentro límites sostenibles. Por ello, aún en el caso improbable de que estudios futuros indicaran que, en evaluaciones anteriores, se han sobrestimado los beneficios ecológicos y socioeconómicos inmediatos, la conservación y posible restauración de los manglares seguirían constituyendo objetivos indiscutibles. Por consiguiente, es probable que una esfera importante para las investigaciones futuras sean las formas rentables desde el punto de vista social y económico de restablecer los manglares en distintas condiciones climáticas y geofísicas. Estudios muy recientes sobre la utilización de la capacidad de asimilación de las zonas de manglares para tratar los efluentes de los estanques camaroneros indican la posibilidad de que se complementen los intereses relativos a la conservación y restauración de los manglares y los del cultivo del camarón.

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[1] La FAO contrató al Centre for the Economics and Management of Aquatic Resources (CEMARE), de la Universidad de Portsmouth, Reino Unido, para hacer un examen de la literatura sobre el cultivo del camarón centrándose en las cuestiones de política y ordenación. Aunque la publicación resultante que se facilita a esta Consulta no representa la opinión de la FAO, el presente documento se basa en varios de los resultados de dicho examen.

La comprobación de que las zonas de manglares no son adecuadas para el cultivo del camarón implicaba que es necesario construir los estanques en zonas ya utilizadas para la agricultura, principalmente para el cultivo del arroz o en otras zonas costeras. Al mismo tiempo, mejoró notablemente la tecnología del cultivo del camarón en los sectores de la cría en incubadoras, la composición y fabricación de los piensos, la estrategia de la alimentación, la densidad de población y la gestión sanitaria e higiénica, lo que hizo aumentar espectacularmente la producción alcanzable por unidad de superficie. Estos aumentos de productividad fueron decisivos para mantener la competitividad de los productores en el mercado internacional del camarón donde el rápido aumento de los suministros mundiales había provocado un descenso real de los precios a fines de los años ochenta y comienzos de los noventa.

La evolución hacia sistemas de cultivo más intensivo y con insumos elevados , impulsada por los adelantos tecnológicos, la competencia internacional y la escasez relativa de tierras especialmente en la región asiática, dieron lugar a nuevos tipos de preocupaciones que empezaron a aparecer desde fines de los años ochenta y han sido objeto de la atención mundial en los últimos años. Cabe señalar entre ellas las espectacultares pérdidas de producción causadas por brotes epidémicos de enfermedades virales; la utilización excesiva de la capacidad de asimilación de residuos de las aguas costeras y las acuíferas de agua dulce; la obstrucción del acceso de comunidades costeras a los recursos comunales; los efectos nutricionales, socioeconómicos y culturales de la conversión de sistemas de cultivo agrícola múltiple, incluyendo el arroz, al cultivo del camarón; y en algunos casos, el desplazamiento obligado de los campesinos fuera de sus tierras. Si bien, especialmente en Asia, gran parte del cultivo del camarón se realiza en granjas de tamaño pequeño y mediano, los problemas planteados por dicho cultivo se relacionan principalmente, en gran parte de la literatura, con intereses comerciales de grandes empresas que intervienen en el cultivo del camarón, el suministro de insumos esenciales como piensos y productos químicos, y/o la elaboración, comercialización y distribución del camarón. Aunque es innegable que las grandes empresas figuran entre los beneficiarios importantes de la expansión del cultivo del camarón, al estudiar la evolución futura de esta actividad no se puede ignorar la dependencia económica de un gran número de productores de camarón, recolectores de semillas y participantes en la elaboración del camarón y otras actividades auxiliares. En gran parte de la literatura, se han ignorado totalmente no sólo los beneficios, sino también las cargas de dicha actividad.

Varias de las obras más recientes han hecho sugerencias valiosas y constructivas sobre la forma en que debería organizarse la producción del camarón de forma sostenible y sobre el tipo de incentivos que deberían crearse para estimular a los agricultores, a los abastecedores de insumos y a otros interesados a adoptar buenas prácticas. Tales sugerencias varían desde una mejor integración del cultivo del camarón en la ordenación de zonas costeras, hasta una mayor eficiencia en la utilización de los distintos insumos para reducir la merma de los recursos naturales y la evacuación de residuos en el medio ambiente, así como las medidas para incrementar los beneficios económicos y sociales, sobre todo a nivel local.

En relación con el desarrollo de la acuicultura en general, el Código de Conducta para la Pesca Responsable, refleja en su Artículo 9 un consenso internacional de amplia base sobre los principios que deben aplicarse para fomentar la acuicultura de forma sostenible y responsable. Existe un consenso cada vez mayor sobre la necesidad de medidas a varios niveles para aplicar estos principios en el cultivo del camarón: a nivel del productor individual, grupos y asociaciones de productores, abastecedores de insumos, distribuidores y comerciantes de camarón, así como al nivel de los gobiernos locales, provinciales y nacionales. Existe también un consenso cada vez mayor sobre el hecho de que todos estos actores se beneficiarán de la mejora en las prácticas y los sistemas públicos de regulación. Sin embargo, parece que no se reconocen suficientemente las dificultades que deberían superarse en lo que respecta a la mejora de los conocimientos tecnológicos de los agricultores y su capacidad de cambiar sus prácticas, a su acceso a la tecnología y la financiación, a su organización en grupos y asociaciones, a la capacidad y disponibilidad de los gobiernos locales, provinciales y nacionales para mejorar sus prácticas regulatorias y de cumplimiento de las leyes, a la capacidad de los suministradores de controlar las actividades de sus agentes locales, a la asistencia a los recolectores de semillas para que se dediquen a otras ocupaciones, y a otros aspectos. A falta de una evaluación realista de estas necesidades humanas, financieras y de organización en los distintos países y zonas costeras, es posible que se establezcan para el cultivo actual del camarón objetivos y marcos cronológicos imposibles de alcanzar. Esto podría crear después expectativas incolmables entre el público en general y los consumidores, cuyo comportamiento adquisitivo puede responder a las condiciones ambientales y socioeconómicas en que se realiza la producción.

## Conclusión

Ningún otro tipo de acuicultura ha atraido tanta atención pública mundial como el cultivo del camarón, y ningún otro tipo ha dado lugar a tantas publicaciones en las revistas científicas generales y especializadas durante los últimos años. Las razones de esta gran publicidad son, entre otras, las preocupaciones bien fundadas por el impacto ambiental y socioeconómico del cultivo del camarón y el deseo de mejorar las políticas y prácticas mediante el desarrollo tecnológico y legislativo. Como ocurre con otras cuestiones en las que se centra la atención pública, existe el peligro de que se tienda más a hacer generalizaciones que una evaluación real de las condiciones ecológicas, socioeconómicas y sociopolíticas específicas en que se realiza el cultivo del camarón. Esto puede estimular a buscar soluciones mundiales indiferenciadas a problemas que es preciso analizar en detalle y resolver mediante políticas y medidas adaptadas a un lugar y región específicos y proyectadas y aplicadas con la participación activa de los productores de camarón y otras partes interesadas.

## REVISIÓN DE LA POLÍTICA Y LEGISLACIÓN APLICABLE A LA CAMARONICULTURA

### Introducción

El presente informe ha sido preparado analizando las disposiciones legales aplicables al cultivo del camarón en algunos países. El criterio de selección de los países se ha basado en la documentación disponible en la Oficina Jurídica de la FAO, su Biblioteca y Base de Datos con el propósito de dar un visión lo más acorde posible a la realidad. Los países son: Ecuador, Honduras, Malasia, Sri Lanka y Tailandia. Este informe ha sido completado con algunos documentos presentados por los países que ya eran disponibles, estos son: India y Sri Lanka. El análisis y los documentos relativos a los países ilustran las principales observaciones que aparecen más abajo.

El documento tiene tres secciones: la primera parte se dedica a la exposición de algunos intrumentos internacionales que son relevantes al tema, mientras que las otras dos secciones, más cortas, se dedican al análisis de la legislación nacional.

### Instrumentos internacionales

El objeto de este análisis no es entrar en la validez o no de los distintos intrumentos internacionales que pueden ser de interés en el tema a consideración sino simplemente, referirse de forma sucinta a los mismos. Entre los intrumentos internacionales relevantes debemos señalar:

***El Código de Conducta para la Pesca Responsable ("CCPR")*** que fue adoptado por la Conferencia de la FAO en su 28° período de sesiones en 1995. El Código es muy amplio[1]. Esta compuesto por varios artículos, uno de los cuales se ocupa exclusivamente del desarrollo de la acuicultura[2]. Incluye disposiciones sustantivas relativas al desarrollo responsable de la acuicultura, incluyendo la pesca basada en el cultivo de recursos acuáticos vivos, tanto en zonas sometidas a jurisdicción nacional, como dentro de los ecosistemas acuáticos transfronterizos; la utilización de los recursos genéticos acuáticos para fines de acuicultura, incluida la pesca basada en el cultivo de recursos vivos acuáticos y la acuicultura responsable a nivel de la producción. Algunas disposiciones dedicadas a los aspectos legales de la acuicultura son de especial importancia a los efectos del presente estudio, en las que se insta a los Estados a "establecer, mantener y desarrollar un marco jurídico y administrativo adecuado que facilite el desarrollo de una acuicultura responsable"[3] y además a "regular la utilización, en la acuicultura, de los insumos químicos que sean peligrosos para la salud de las personas y el medio ambiente ".[4] El Código puede ser acompañado de sus propias directrices técnicas, las mismas han sido ya redactadas con respecto a la acuicultura.[5] Otro aspecto relacionado con el tema que nos ocupa se encuentra en el Artículo dedicado a la Integración de la Pesca en la Ordenación de la Zona Costera[6], que dice: "Los Estados deberían velar por que se adopte un marco jurídico, institucional y de definición de políticas apropiado para conseguir la utilización sostenible e integrada de los recursos, teniendo en cuenta la fragilidad de los ecosistemas costeros, el carácter finito de los recursos naturales y las necesidades de las comunidades costeras"[7].

La FAO ha sido por muchos años el centro dónde se han realizado grandes esfuerzos para establecer un sistema mundial de cooperación en el control de plaguicidas a través del intercambio de información técnica y de decisiones administrativas. A través de la Resolución 10/85, la Conferencia de la FAO adoptó en 1985 el ***"Código Internacional de Conducta para la Distribución y Utilización de Plaguicidas "***. Uno de sus principales objetivos es "enunciar las responsabilidades y establecer normas de conducta de carácter voluntario para las entidades públicas y privadas que intervienen o influyen en la distribución y utilización de plaguicidas, particularmente en los casos en que no hay una legislación nacional para regular los plaguicidas, o la que existe es inadecuada".[1] El Código prevé directrices para el manejo, ensayo, disponibilidad y utilización, distribución y comercio, publicidad, etiquetado, envasado, almacenamiento y eliminación de plaguicidas. Se dedica a las actividades para reducir los peligros para la salud, requisitos reglamentarios y técnicos para los gobiernos y la industria, principio de intercambio de información y consentimiento previos y sus procedimientos respectivos cumplimiento del Código y seguimiento de su aplicación. La legislación nacional deberá "traducir" los contenidos del Código y permitir su ejecución. Se han dado algunas directrices con este propósito.[2]

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[1] El Artículo 1 dice "es de aplicación mundial y está dirigido a los miembros y no miembros de la FAO, a las entidades pesqueras, a las organizaciones subregionales, regionales y mundiales, tanto gubernamentales como no gubernamentales, y a todas las personas involucradas en la conservación de los recursos pesqueros y la ordenación y el desarrollo de la pesca, tales como los pescadores y aquellos que se dedican al procesamiento y comercialización de pescado y productos pesqueros así como otros usuarios del medio ambiente acuático que tiene relación con la actividad pesquera". El mismo Artículo añade además: "abarca también la captura, el procesamiento, y el comercio de pescado y productos pesqueros,.la acuicultura,..."

[2] Artículo 9 del Código.

[3] CCPR, 9.1.1

[4] CCPR,9.4.5.

[5] FAO Directrices Técnicas para la Pesca Responsable, Desarrollo de la Acuicultura, FAO, Roma 1997.

[6] CCPR, Artículo 10.

[7] CCPR, 10.1.1.

Por lo que respecta a la alimentación, existe una normalización definida (por ejemplo, requisitos precisos con respecto a los que los productos pueden ser controlados) y también codigos de prácticas. La tendencia hacia normas generales se observa en la legislación nacional e internacional en el **Programa Conjunto FAO/OMS sobre normas alimentarias - Comité del Codex Alimentarius.** El Codex Alimentarius es un "compendio de normas alimentarias aceptadas internacionalmente y presentadas de forma uniforme"[3]. Como tal contempla , entre otras, disposiciones relativas a los aditivos alimentarios, residuos de plaguicidas, contaminantes incluyendo los aplicados al pescado y productos pesqueros, incluyendo por último pero no último lugar "los productos acuícolas". Un Anteproyecto de Codigó de Prácticas de Higiene para Productos de Acuicultura ha sido preparado, enmendado y redactado desde 1990 por el Servicio de Utilización y Mercadeo de la FAO y discutido recientemente en el Comité del Codex sobre pescado y productos pesqueros en Noruega. El objeto de este Código de Prácticas esta limitado a "peces con aletas y crustáceos producidos por la acuicultura comercial con eventual interés en el consumo humano". Contiene directrices generales para el establecimiento y conducción de la producción dentro de los más fundamentales requisitos de higiene, desde la cosecha de peces vivos hasta la carga para transporte al mercado. El proceso de matanza no está considerado".[4] Se ha realizado "con el propósito de informar y de servir como guía para la elaboración de normas a nivel nacional, sobre control de calidad, reglamentos relativos a la inspección del pescado en aquellos países en los que estos no han sido todavía desarrollados. Además, pueden ser utilizadas con el propósito de capacitar a los acuicultores y a los empleados del sector acuicola".[5] En otras palabras, la aplicación del Código de Prácticas deberá ser adaptada a las necesidades nacionales y locales, a sus prioridades y requisitos.

El acceso al mercado que se deriva de las diferencias entre los productos en las distintas jurisdicciones ha recibido la atención en el contexto de la Organización Mundial del Comercio (OMC). De importancia en este sentido son el **Acuerdo sobre la Aplicación de Medidas Sanitarias y Fitosanitarias (el acuerdo SFS) y el Acuerdo sobre Obstáculos Técnicos al Comercio ( el acuerdo OTC)** adoptados por los miembros del GATT después de la Ronda de Uruguay. El objetivo básico de estos dos Acuerdos es limitar la utilización de medidas (características técnicas de los productos y requisitos de salud) que restringen o pueden restringir, el comercio a aquellos que son capaces de demostrar a los países importadores el nivel de protección necesario. Temporalmente, sin embargo, los Miembros mantienen el derecho fundamental a protegerse a sí mismos, al nivel que determinen necesario, y por lo tanto, a adoptar y aplicar las normas sobre medio ambiente apropiadas. En el Acuerdo SFS se reconoce la importante contribución de las normas, directrices y recomendaciones internacionales con respecto al desarrollo, adopción y aplicación de las normas sanitarias y fitosanitarias, alentando la utilización de normas sanitarias y fitosanitarias armonizadas [6] entre los Miembros , en base a normas internacionales, directrices y recomendaciones desarrolladas por las organizaciones internacionales más importantes incluyendo la Comisión del Codex Alimentarius. Por lo que respecta al OTC el objetivo es garantizar que no se creen obstáculos innecesarios y minimizar su efecto con respecto al comercio internacional. Las medidas que afecten al comercio internacional deberán ser lo menos perjudiciales posible y temporales. Cuando las normas del Codex existen y son de importancia a las circunstancias los miembros del GATT deben basar sus medidas en ellas.

Ambos acuerdos dedican especial importancia a la "transparencia" en el desarrollo y aplicación de las medidas de limitación al comercio (medidas regulatorias). Ello presupone requisitos para la notificación del interés en introducir esas medidas en un momento inicial. Cuando una norma internacional, una directriz o recomendación no existe o el contenido de la medida propuesta no es sustancialmente igual al contenido de la norma internacional, directriz o recomendación y aquella medida puede afectar el comercio con respecto a otros Miembros[7]. La incorporación de referencias a las normas del Codex y Códigos de Prácticas del Codex en los Acuerdos del GATT deberían contribuir sustacialmente al desarrollo del comercio internacional en productos alimenticios y a reducir los problemas derivados de las diferentes legislaciones nacionales[1]. Ello deberá llevar a aumentar la coordinación e integración entre el Codex y los sistemas nacionales y las aproximaciones para aprobar aditivos en los alimentos y para establecer tolerancia a los contaminantes.

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[1] Artículo 1.1.

[2] Por ejemplo, Directrices para la Legislación sobre el Control de los Plaguicidas, Directrices para el Registro y Control de los Plaguicidas, Directrices para el Correcto Etiquetado de Plaguicidas.

[3] Codex Alimentarius, requisitos generales, segunda edición, revisada en 1995.

[4] Comisión del Codex Alimentarius, Anteproyecto del Códigos de Prácticas de Higiene para Productos de Acuicultura, CX/FFP96/7.

[5] Comisión del Codex Alimentarius, Anteproyecto del Códigos de Prácticas de Higiene para Productos de Acuicultura, CX/FFP96/7.

[6] Ver definición en el Acuerdo sobre la aplicación de medidas Sanitarias y Fitosanitarias, en el anexo.

[7] Anexo B del Acuerdo SPS.

Aparte de los mencionados instrumentos existen otros acuerdos internacionales que pueden ser de importancia: La Convención de Ramsar sobre las Zonas Húmedas de Importancia Internacional especialmente como Hábitat de las Aves Acuáticas (1971) y la Convención de la UNESCO para la Protección del Patrimonio Mundial y Cultural (Paris, 1972), ambas basadas en la protección "in situ". Ambas Convenciones establecen obligaciones generales y normas de comportamiento dejando a cada Estado miembro emanar y aplicar su propia legislación de acuerdo con sus propias necesidades y prioridades. Ninguno de estos dos Acuerdos define ningún tipo de área protegida o exige la adopción de cualquier tipo de medida de protección. Normalmente han sido completados con textos regionales más detallados.

## Políticas nacionales

Las políticas nacionales con relación al cultivo del camarón han jugado y están jugando un papel muy importante en el desarrollo de la industria de la camaronicultura. Se concentran en su mayor parte en otorgar soporte técnico y financiero a la industria del camarón. Este ha sido el caso en particular de India, Sri Lanka y Tailandia. Los objetivos perseguidos fueron, inicialmente, el desarrollo de la industria y el aumento en las ganancias en divisas y más tarde la promoción del cultivo del camarón de forma sostenible y sin dañar al medio ambiente. En cuanto al soporte financiero este incluye facilidades en el otorgamiento de préstamos para el desarrollo de la industria, exenciones fiscales para la importación de productos (alimentos, semillas, equipo de laboratorio, etc) así como, condiciones de acceso favorables para la inversión extranjera. Con la llegada de cambios sociales y en el medio ambiente, los incentivos financieros se movieron hacia la provisión de subsidios por parte del gobierno para la introducción de "equipos verdes" y se introdujo soporte técnico. Este se centró en la provisión de servicios de extensión con el objeto de disminuir las enfermedades del camarón, mejorar la producción (cantidad y calidad) así como, desarrollar el cultivo sostenible del camarón y no perjudicial al medio ambiente. Por dificultades desde el punto de vista social y de medio ambiente algunos países como Tailandia dieron especial importania a las disposiciones sobre soporte técnico a los acuicultores de mediana y pequeña escala. Ello llevó a una estracha colaboración entre el gobierno y los acuicultores en la aplicación de las políticas del gobierno. A raiz de este problema se observa que cuando el gobierno no toma en consideración la situación social del país los conflictos sociales y los problemas ecológicos aumentan. Las acciones llevan a una inversión insostenible. Aparte de este soporte, los gobiernos introdujeron una política de arrendamiento de terrenos con vistas a facilitar el acceso a las zonas costeras (India), a la protección de los manglares (Ecuador) y a organizar la distribución de los recursos costeros (Sri Lanka, Ecuador y Tailandia). Se introdujeron sistemas de zonifiación para establecer granjas dedicadas al cultivo del camarón.

## Legislación nacional

Los marcos de regulación del desarrollo de la acuicultura en general, y de la camaronicultura en particular, son institucional y legalmente complejos. El cultivo del camarón tiene lugar en las zonas costeras donde la situación es complicada y las preocupaciones de los grupos de interés legítimas. Típicamente, se trata de un tipo de legislación que se ocupa de varios aspectos como: la planificación y utilización del terreno, la calidad de las aguas, movimientos de los peces y enfermedades, usos farmaceúticos, calidad de los alimentos y salud pública. También típicamente estan involucradas varias instituciones competentes en estos temas. Así , parecen existir más leyes que mecanismos para su aplicación.

***Los factores que dan lugar a cuestiones legales con respecto al desarrollo y manejo del cultivo del camarón son los siguientes:***

* el cultivo del camarón incluye la producción en la mayoría de los casos en recursos de dominio público por ejemplo, agua, independientemente de que se trate de aguas marinas o continentales, zonas costeras, playas, zonas húmedas y manglares,etc. Normalmente pertenecientes al Estado (de dominio público);
* los productos resultado del cultivo del camarón deben estar listos para el consumo humano (tanto en el mercado nacional como internacional);
* necesidad de encontrar un equilibrio entre la operación de producción continua de una granja acuicola y la conservación de los recursos naturales;

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[1] R.J. Ronk y D. Dodgen, "Normas sobre Alimentos: una estrategia global de requisitos comunes aplicables a todos los alimentos ", Conferencia de la FAO/OMS sobre Normas para Alimentos, Químicos en los Alimentos y Comercio de Alimentos, ALICOM 91/6.

* el cultivo de camarón depende de la calidad y cantidad de agua y tierra por lo tanto, es vulnerable a los cambios causados por otros usuarios de los mismos recursos así como sometidos a alteraciones de los recursos compartidos;
* el cultivo del camarón se realiza en recursos muy valiosos (recursos costeros) que son utilizados normalmente de forma intensiva por los humanos y por lo tanto sometidos a competencia.

Las leyes y los reglamentos que se ocupan específicamente del cultivo del camarón no son muy frecuentes. El primer objetivo de las disposiciones existentes relativas a la camaronicultura responden a la necesidad de: protección del desarrollo de la actividad (por ejemplo, regular el acceso o estimular la inversión), ocuparse de algunos aspectos del manejo (tratamiento de la calidad de las aguas) o de aspectos específicos relativos a la contaminación del medio ambiente y a su degradación, que están afectando y/o son causadas por el desarrollo y el ejercicio de actividades de cultivo del camarón, (por ejemplo, la destrucción de manglares).

En los países que han sido analizados **se han encontrado las siguientes medidas**:

1. medidas preventivas: técnicas de autorización (*Ecuador, Honduras, Sri Lanka, (sistema uniforme) India, Malaysia (dos sistemas), Tailandia*)[1], sistema de Estudio de Impacto Ambiental (*Sri Lanka, India, Honduras*), zonificación (*Ecuador, Sri Lanka, India, Tailandia*), lista de actividades que deben ser restringidas o prohibidas así como normas establecidas con relación a los aspectos de desarrollo y manejo (*Ecuador, Sri Lanka, Tailandia*); las reglas no se aplican de forma invariable a todas las granjas de cultivo de camarón: generalmente las granjas están clasificadas basándose en la producción por hectárea/año (*India2)*o por la dimensión de la granja (*Malasia);* de conformidad se imponen diferentes parámetros y condiciones; la zonificación es normalmente el resultado de una protección integrada del medio ambiente de la zona costera basada principalmente en la regulación de determinadas actividades humanas y la planificación del uso de un determinado espacio y no en el uso de determinadas sustancias.

2. incentivos económicos para la protección del medio ambiente: cargas de efluentes (*Sri Lanka*), incentivos fiscales (*Ecuador, Honduras, Sri Lanka*), esquemas de depósitos (*India, Tamilnadu the Eco-fund*), coste por uso (*Thailand*), etc. Todos ellos de una u otra forma tienen como objetivo explícitamente asegurar instalaciones que sean no dañinas del medio ambiente tanto en la fase de construcción como al terminar la actividad. En *India* y Sri Lanka existen políticas-bancarias para préstamos. Estas contribuyen significativamente al desarrollo de la camaronicultura pero no tienen en consideración el comportamiento con respecto al medio ambiente como factor de otorgamiento o no del crédito. Sin embargo, recientemente, en Sri Lanka se han establecido sistemas de préstamos que se otorgaban a las granjas con sistema de tratamiento de aguas o sistemas de recirculación. De importancia en ese país es la denominada "eco-duty"impuesta por cada kilo de camarón exportado para reembolsar al gobierno por los "gastos de medio ambiente".

3. con algunas excepciones en el caso de *Tailandia* y *Malasia (Estado de Kedah*), no existe ningún país en el que se haya centralizado el control, monitoreo y la valoración en una única agencia del gobierno, no existe una red de instituciones descentralizadas coordinadas por una institución nacional o agencia, no existe un control por parte de los que realizan la actividad. En general se ha depositado la confianza en un control, monitoreo y valoración sectorial no coordinada por parte del Estado y en un control voluntario por parte de los acuicultores;

4. los medios para la aplicación incluyen acciones civiles (*Malasia*), recursos administrativos, tales como multas, denegación, suspension, revocación (*Honduras, Ecuador, Sri Lanka*) y sanciones penales (*Malasia*). Las leyes relativas al medio ambiente permiten normalmente que las agencias impongan multas a los que incumplen. Estas pueden ser individuales o colectivas (corporaciones) y se aumentan sustancialmente por repetida mala conducta . En la legislación nacional revisada se observa un incremento en la imposición de responsabilidad criminal en aquellos que contaminan y

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[1] entre los países en revisión la mayor parte de ellos tienen un sistema general de licencias para acuicultura, independientemente del tipo de especies que se cultiven, con independencia de los objetivos que se persigan, con independencia del sistema que se utilice, con independencia de la producción que se prevé.

[2] En **India**, con relación al **Tamil Nadu** (Reglamento), 1995 se aplica a todas las "unidades costeras dedicadas a la acuicultura", las Directrices del Gobierno para el Manejo y Desarrollo Sostenible de la Acuicultura en Aguas Salobres establece una distinción entre acuicultura salobre extensiva (por ejemplo, máximo 2 toneladas/hectárea/año) y la acuicultura semi-intensiva e intensiva (por ejemplo 5 toneladas/hectárea/año- 2 cosechas) con el propósito de aplicar las Directrices del Gobierno para el Manejo y Desarrollo Sostenible de la Acuicultura en Aguas Salobres, 1995.

realizan otros actos que dañan o perjudican el medio ambiente ( por ejemplo delitos en el caso de que una persona cause o sabiéndolo permita, cualquier sustancia venenosa, nociva o contaminante entrar en la zona costera).

5. Códigos de práctica: el concepto en acuicultura es bastante nuevo. El objetivo es servir de guía para el establecimiento y la conducción de operaciones de acuicultura que no sean dañinas al medio ambiente (*India, Sri Lanka*). El alcance está limitado a sistemas de acuicultura específicos (*India*)[1] aunque también sucede que los códigos puedan dedicarse al desarrollo de la acuicultura en general (*Sri Lanka*). En ambos casos deberán ser emitidos por la autoridad estatal.

En muchos países las leyes y reglamentos que se ocupan directa o indirectamente del desarrollo del cultivo de camarón pueden constituir un punto de partida adecuado para el manejo del desarrollo de estas actividades y en particular, para regular el acceso, tratar los conflictos de los ususarios y proteger el medio ambiente. Sin embargo, no son en ocasiones totalmente utilizados por falta de un soporte institucional adecuado para la efectiva y coordinada aplicación. En ocasiones la aplicación no existe. Parece que existe mayor necesidad de codificar reglas dispares que de diseñar nuevas reglas. Por otra parte, la necesidad de mejorar la aplicación puede necesitar de nueva legislación y de una reforma institucional.

### *Elementos que impiden la efectividad de las decisiones institucionales, las leyes y los reglamentos*

Existen varios factores legales y decisiones institucionales que pueden impedir la efectividad de las políticas y la legislación y que pueden constituir un obstáculo para que las políticas y la legislación alcancen los resultados deseados. Cuando una legislación o una política no obtiene los resultados deseados, uno no puede solamente hacer caso de: la falta de diseño adecuado, la falta de recursos, la falta de consulta pública adecuada, la falta de capacitación, un comportamiento oportunista o instituciones demasiado centralizadas como las únicas causas del problema aunque, algunos de estos factores influyen en la no-efectividad de las políticas y la legislación.

La políticas han sido diseñadas normalmente de forma reactiva más que activa. Por ello, se han tomado decisiones precipitadamente como respuesta a problemas urgentes y las autoridades no han considerado el impacto que se produce en la gente y las circunstacias de las propuestas de nuevas políticas y reglas así como, su practicidad.

Desde un punto de vista estrictamente legal la acuicultura , incluida la camaronicultura, se regula en la legislación pesquera básica cuando debería contar con una serie de normas específicas. Existe una necesidad de poner de relieve la diferencia entre la acuicultua y las operaciones pesqueras. Ello puede resultar en dificultades en la clasificación de esta actividad. La ambiguedad no es necesariamente algo negativo pero puede ser problemática a nivel de la implementación de las leyes y los reglamentos. Las reglas aplicables a la acuicultura a veces son redactadas sin tener presente la acuicultura. Típicamente, pocos plaguicidas han sido registrados para el uso en la acuicultura cuando sin embargo, han sido registrados para otros usos. Finalmente, aparte de crear conciencia de los impactos sectoriales de los proyectos de camaronicultura el marco institucional está ampliamente caracterizado por un enfoque sectorial y el control sobre el cultivo del camarón no siempre tiene una identidad institucional. Por ello, las decisiones de aplicación pueden no ser las más adecuadas.

### Conclusiones

Las propuestas de políticas así como de leyes y reglamentos para que sean aplicadas tienen que cumplir con su objetivo. En este sentido se debe prestar consideración a:

- la naturaleza del problema;
- el propósito de la política y la legislación propuesta: su espíritu e intención;
- la razón por la cual esos propósitos tienen que ser logrados: cómo funcionará el sistema, practicidad de la maquinaria propuesta;
- el impacto de la propuesta en las circunstancias existentes y en otras políticas y leyes.

La experiencia confirma la existencia de una ilusión extendida por la que legislar con respecto a un problema es en si solucionar el problema, como si la legislación tuviera una acción mística, en vez de crear un marco jurídico para la acción. Los gobiernos pueden estar impulsados a emanar legislación rápidamente en forma de olvidar el tomar en consideración la capacidad de la legislación propuesta para ser administrada de forma efectiva y equitativa.

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[1] Las Directrices de la India mencionadas arriba se pretende que sean útiles "en formular prácticas de manejo de las granjas adecuadas y en adoptar medidas que disminuyan los impactos ambientales para el manejo de los residuos de los estanques de camarón y la utilización de los recursos terrestres y acuáticos de una forma juiciosa". Las prácticas de manejo y normas que deben ser adoptadas por los camaronicultores y las autoridades están indicadas contemporanéamente.

Sin embargo, la complejidad de los problemas puede hacer difícil el incorporar todos los temas relativos al cultivo del camarón en un texto único. Ello puede dar a una razón para considerar el uso de códigos para regular la actividad del cultivo de camarón. Estos ofrecen la ventaja de ser más flexibles y más fáciles de modificar. La reglas que originariamente surgen como directrices o recomendaciones pueden tener una gran "carrera jurídica" de forma que pueden desarrollar en poco tiempo normas vinculantes. Ello sucede cuando estas recomendaciones o directrices son aceptadas por la mayoría de las personas a quienes las mismas afectan.

# GRUPO DE TRABAJO A

## MARCOS JURÍDICO, INSTITUCIONAL Y CONSULTIVO PARA EL FOMENTO Y LA ORDENACIÓN DEL CULTIVO DEL CAMARÓN

## GUÍA PARA EL DEBATE

### Antecedentes

El marco jurídico que regule la acuicultura debe basarse en un conocimiento interdisciplinario sólido, ser suficientemente flexible para tener en cuenta los cambios dinámicos en el medio ambiente y las condiciones socioeconómicas y, quizás paradójicamente, tener una orientación a largo plazo.

Dicho marco debería contribuir a mantener el equilibrio ecológico en un futuro imprevisto y, en particular, afrontar la amenaza potencial de la irreversibilidad de los impactos. Los legisladores deben aceptar el hecho de que los daños ambientales pueden ser permanentes, como ocurre, por ejemplo, con la extinción de especies de fauna silvestre. Esto determina la necesidad de centrar los esfuerzos en medidas preventivas, teniendo en cuenta la incertidumbre que ello entraña, en lugar de adoptar los remedios jurídicos tradicionales contra la violación de la ley.

Se reconoce que las actuales disposiciones jurídicas, institucionales y consultivas no son, en muchas situaciones, propicias para fomentar el desarrollo del cultivo del camarón de forma sostenible.

Algunas de las deficiencias de las actuales disposiciones jurídicas e institucionales son las siguientes:

- la integración de la acuicultura, incluido el cultivo del camarón, en la legislación básica sobre pesca;

- la falta de una legislación sobre el cultivo costero del camarón, ya sea específicamente, o bien dentro de un marco jurídico relacionado con el desarrollo costero en general;

- insuficiencia de la legislación sobre el uso de la tierra, en particular las tierras estatales en zonas costeras;

- la falta de dispositivos jurídicos e institucionales para regular la utilización de otros recursos de propiedad común que sirven como insumos al cultivo del camarón, en particular, el agua dulce procedente de acuíferas costeras y post larvas recogidas del estado silvestre;

- legislación deficiente o no aplicada sobre la utilización de productos químicos en el cultivo del camarón y sobre el tratamiento de efluentes de las granjas camaroneras;

- competencias conflictivas y superpuestas de instituciones gubernamentales debido a la dispersión y variedad de los reglamentos ambientales, e insuficiencias administrativas con respecto al control y seguimiento de las actividades costeras, incluidas las de cultivo del camarón;

- falta de procedimientos obligatorios para la planificación del desarrollo costero y los correspondientes mecanismos consultivos entre los distintos órganos gubernamentales competentes, con respecto al cultivo del camarón y a los usuarios de los recursos y comunidades costeras en general.

Las deficiencias de los regímenes jurídicos no son siempre la única ni siquiera la principal razón de que la expansión de cultivo del camarón haya sido a veces caótica y se haya enfrentado con distintos problemas bien conocidos. El desconocimiento y la aplicación y obligatoriedad insuficientes de las leyes y reglamentos vigentes, incluidos los ambientales, son en muchos casos factores que contribuyen o incluso la razón principal de las prácticas insostenibles. Los gobiernos nacionales, provinciales y locales adolecen de distintas insuficiencias institucionales que impiden la aplicación eficaz de las leyes en general, y no sólo de las relacionadas con el cultivo del camarón. Por consiguiente, una base jurídica adecuada es una condición necesaria para lograr prácticas sostenibles, pero en manera alguna es la condición suficiente. Aunque se necesita una aplicación de las leyes basada en el control del cumplimiento realizado por las autoridades competentes y en el enjuiciamiento y penalización de las violaciones, no deberá infravalorarse la función potencial de medios tradicionales de control y castigo del incumplimiento mediante la presión ejercida por los demás participantes en el sector y el ostracismo. Los sistemas tradicionales pueden ser especialmente importantes en situaciones en que el cultivo del camarón lo realizan en pequeña escala un gran número de piscicultores cuyas actividades difícilmente podrían ser controladas exclusivamente mediante los procedimientos formales para hacer cumplir las leyes.

Se considera que se facilitaría mucho la aplicación de las leyes mediante métodos tanto modernos como tradicionales, si hubiera una conciencia suficiente sobre los motivos de las distintas medidas reglamentarias y los beneficios inmediatos y a largo plazo que se derivarán del cumplimiento de los reglamentos. Es probable que en la mayoría de las situaciones se necesiten servicios de extensión, campañas de concienciación y otras actividades de formación. Todo ello contribuirá también a un proceso de información y consultas entre las distintas partes interesadas en el cultivo del camarón y el desarrollo costero.

### Resultados esperados

Hay tres tipos de resultados que cabe esperar de las deliberaciones del Grupo de Trabajo (GT):

1. Principios rectores para los marcos jurídico, institucional y consultivo con vistas al fomento y la ordenación del cultivo del camarón.

2. La sección del proyecto del esquema anotado de directrices previstas sobre políticas para el cultivo sostenible del camarón, referentes a los dispositivos jurídicos, institucionales y consultivos.

3. Sugerencias sobre el tipo de seguimiento necesario para a) tratar esta sección de las directrices y b) promover su difusión y aplicación efectiva.

Los principios rectores podrían relacionarse con los puntos siguientes:

- los aspectos de desarrollo y ordenación del cultivo del camarón que deberían regularse mediante leyes y reglamentos específicos; en otras palabras, las circunstancias y problemas que las propuestas legislativas deben afrontar, las finalidades primordiales y los grupos de destinatarios primarios de dicha legislación;

- la aplicación efectiva puede referirse a: medios tradicionales (presión por otros participantes en el sector, proscripción social), imposición legal y control (multas, prisión), decisiones administrativas (cierre de un establecimiento), compensación monetaria a los perjudicados por el medio ambiente, medidas fiscales (reducciones fiscales para la fabricación, venta y utilización de productos ecológicos o imposición de recargos a productos y procesos perjudiciales para el medio ambiente), préstamos por razones ecológicas, ecofondos;

- los niveles administrativos (nacional, provincial o local) a que debe establecerse la autoridad legislativa para los distintos aspectos del fomento y la ordenación; sectores especiales de responsabilidad;

- los tipos de mecanismos consultivos necesarios a los distintos niveles administrativos y los medios requeridos para garantizar que haya un proceso de adopción de decisiones con conocimiento de causa; cuando y en qué medida habrán de celebrarse consultas dentro y fuera de los distintos organismos gubernamentales; las funciones de las estructuras tradicionales de adopción de decisiones a nivel local;

- los procedimientos que han de seguirse y los mecanismos consultivos necesarios para garantizar la coordinación con respecto a la aplicación y cumplimiento de las leyes y reglamentos; las soluciones de conflictos entre los distintos órganos gubernamentales;

- cobertura de los gastos de los dispositivos jurídicos, institucionales y consultivos.

Con respecto a las directrices previstas, el GT podría examinar en primer lugar cuáles deberán ser los grupos destinatarios y si se necesitan distintas series de directrices para los distintos grupos destinatarios. Con respecto a los aspectos jurídicos, el GT podría examinar la utilidad potencial de elaborar una legislación modelo para el cultivo costero del camarón y las zonas que han de abarcarse.

Teniendo en cuenta que muchos países están elaborando o prevén elaborar dispositivos jurídicos e institucionales específicos para la ordenación costera integrada, el GT podría examinar la forma mejor de satisfacer mediante ellos las necesidades específicas del cultivo costero del camarón. Asimismo el GT podría estudiar los requisitos específicos de la evaluación del impacto ambiental del fomento del cultivo del camarón, teniendo presente el problema de la agregación de los impactos de las granjas camaroneras cuyos efectos ambientales, si se evalúan individualmente, pueden no superar los niveles prescritos. El GT podría estudiar también los tipos de impactos económicos, sociales y nutricionales a nivel de hogares, comunidades y regiones, que pueden ser objeto de procedimientos de evaluación formal.

El GT podría estudiar las medidas que habrían de adoptarse para fomentar y facilitar regímenes de ordenación autoregulatorios, especialmente entre los productores de camarón en pequeña escala, inclusive su organización en grupos o asociaciones, y las funciones de los servicios de extensión y capacitación gubernamentales y/o privados.

Con respecto a los aspectos institucionales, el GT podría examinar las funciones específicas que los departamentos de pesca deben desempeñar, como la coordinación entre departamentos, planificación, concesión de licencias, seguimiento, control y vigilancia, etc.

En relación con la redacción de las directrices, el GT podría proponer los tipos de colaboradores que la FAO debería asociar a esta tarea y el tipo de procesos de revisión a que habría que someterlas antes de su redacción final y publicación. El GT podría asesorar también sobre el tiempo necesario para esta tarea.

Por último, el GT podría examinar las funciones y los medios de los distintos actores (p.e., gobiernos, industria, piscicultores y sus asociaciones y organizaciones regionales e internacionales, incluida la FAO) para promover y facilitar la adopción de las directrices.

## GRUPO DE TRABAJO B

## PLANIFICACIÓN, MÉTODOS E INSTRUMENTOS REGLAMENTARIOS Y PLANES DE INCENTIVOS ECONÓMICOS PARA EL FOMENTO Y LA ORDENACIÓN DEL CULTIVO DEL CAMARÓN

## GUÍA PARA EL DEBATE

### Antecedentes

Se reconoce comúnmente la función indispensable de la intervención gubernamental a los distintos niveles para garantizar que el desarrollo del cultivo del camarón se realice de forma sostenible y responsable. Se reconoce también cada vez más la necesidad de cooperación entre los piscicultores y empresas que producen camarón en la planificación y regulación, así como la posibilidad de que ellos mismos adopten medidas autoregulatorias. De igual forma, hay que tener en cuenta los intereses de otros sectores económicos de las zonas costeras donde se cultiva el camarón para garantizar un desarrollo bien integrado.

El cultivo del camarón se realiza en condiciones ambientales, económicas, sociales y políticas muy diversas, por lo que no existe un sistema de planificación y reglamentación que pueda considerarse el mejor. Es más, la escala y la tecnología de la cría del camarón y las condiciones económicas de los productores difieren notablemente. Estas variaciones pueden reflejarse en la interpretación detallada de lo que se entiende por "cría sostenible del camarón" en una determinada zona geográfica.

Pese a la variabilidad de las formas, los lugares y las condiciones en que se realiza el cultivo del camarón, hay acuerdo general sobre determinadas cuestiones de ordenación que es preciso afrontar. La primera, y posiblemente la más importante, consideración es el emplazamiento de los estanques y las correspondientes instalaciones de infraestructura. Es posible que la actual planificación del uso de la tierra que realizan los gobiernos no se aplique a los lugares donde se establecen las granjas camaroneras o que no se haga una distinción entre el cultivo del camarón y otras actividades agrícolas, como el cultivo del arroz. Como consecuencia de ello, las decisiones sobre la utilización de la tierra y la ubicación de las granjas están determinadas principalmente por los incentivos económicos a corto plazo de los inversores privados, incluidos los pequeños piscicultores, quienes deciden destinar las tierras a otros usos, respondiendo a una rentabilidad relativa.

Una segunda serie de problemas de gestión se relaciona con otros insumos de producción además de la tierra, es decir, semillas, piensos, agua dulce, agua salada y productos farmacéuticos y químicos. El carácter común del problema de la gestión en relación con estos insumos es que la utilización de los mismos frecuentemente causa impactos que trascienden los límites de la unidad de producción en la que se toma la decisión sobre la cantidad, la periodicidad y el tipo específico de insumo que se emplea. Estos efectos externos pueden tener repercusiones económicas, sociales y ambientales de largo alcance en otras granjas camaroneras, explotaciones agrícolas, otros usuarios del medio ambiente marino (p.e. el turismo), las comunidades costeras y otros. Un importante tipo de respuesta de política a las externalidades, propugnado por los economistas, pero que se refleja también, por ejemplo, en la Declaración de Río de 1992 sobre el medio ambiente y el desarrollo, es el de intentar internalizar los costos ambientales mediante el principio de quien contamina paga.

Pese al amplio acuerdo con respecto al principio de quien contamina paga, en la práctica real, se aplican mucho más ampliamente normas regulatorias para afrontar las externalidades. En el cultivo del camarón, podrían establecerse normas sobre la fuente de las semillas y la forma en que se producen, la densidad de población máxima en los diferentes ambientes, la composición y cantidad de aplicación de piensos en las distintas condiciones e intensidades de cultivo, la forma en que se obtiene el agua dulce y el agua salada y normas de calidad del agua para su retorno al medio ambiente, y los tipos y dosis de productos químicos que pueden aplicarse en las distintas condiciones naturales y sistemas de cría. Es bastante difícil definir normas de producción de amplia aplicación debido a la diversidad de condiciones, al rápido cambio tecnológico y al hecho de que, para que una norma sea adecuada,no se puede prescindir del número de piscifactorías existentes en una determinada localidad. Asimismo, el establecimiento de normas no puede realizarse independientemente de la capacidad efectiva y las posibilidades de los agricultores de cumplirlas, por una parte, y de las autoridades reglamentarias para hacerlas cumplir mediante un seguimiento adecuado y, en su caso, mediante el enjuiciamiento y la sanción de las violaciones, por otra.

Tanto la aplicación del principio de quien contamina paga como el establecimiento de normas impondrán costos adicionales a cada productor de camarones o a las administraciones gubernamentales. Sin embargo, no se puede establecer a priori que tales costos adicionales sean superiores a los beneficios que los productores y el gobiernos pueden obtener mediante estas respuestas de política. Los beneficios para el gobierno, además de los derechos/impuestos recaudados con la aplicación del principio de quien contamina paga, consisten en un aumento de los impuestos recaudados a causa del rendimiento sostenido y los ingresos de los agricultores (p.e. mediante impuestos de exportación), así como de la reducción potencial del reembolso de la deuda de préstamos extranjeros. En el caso de los productores de camarón los beneficios de una producción sostenida y de la posibilidad de comercializarla son evidentes.

Resultados esperados

Hay tres tipos de resultados que cabe esperar de las deliberaciones del Grupo de Trabajo (GT):

1. Principios rectores para la planificación y métodos reglamentarios, incluidos incentivos económicos, aplicados al cultivo del camarón.

2. La sección del proyecto de esquema anotado de directrices previstas sobre políticas para el cultivo sostenible del camarón, en la que se tratan la planificación y los métodos reglamentarios e incentivos económicos.

3. Sugerencias sobre el tipo de seguimiento necesario para a) redactar esta sección de las directrices y b) promover su difusión y aplicación efectiva.

Teniendo en cuenta la amplia diversidad de contextos ecológicos, económicos, sociales y culturales en que se realiza el cultivo del camarón, el GT debería elaborar específicamente los puntos siguientes:

- los principios que han de seguirse en el emplazamiento de las granjas camaroneras y las ventajas relativas de las medidas de política reglamentaria, incluida la designación de zonas prohibidas para el cultivo del camarón, un proceso de concesión de permisos basado en condiciones específicas y mecanismos de consulta, impuestos/recargos sobre el uso de la tierra para actividades específicas en los casos en que el mercado de la tierra no llega a trasmitir todo el valor económico de la tierra, y otras cuestiones a discreción del GT;

- ámbito y modalidad de aplicación del principio de quien contamina paga y posibles alternativas en los casos en que su aplicación puede ser inapropiada o puede conseguirse el mismo resultado de forma más eficaz mediante otras respuestas de política, como normas regulatorias;

- el ámbito para el establecimiento de normas de amplia aplicación para la producción de insumos y productos y los procesos mediante los cuales podrían prepararse y actualizarse tales normas;

- los tipos de normas que se podrían necesitar a nivel de los ecosistemas y unidades administrativas locales o regionales y los principios que podrían seguirse en su establecimiento y actualización;

- los tipos de mecanismos que se necesitarían para garantizar el cumplimiento de dichas normas;

- las medidas que podrían ser necesarias para facilitar la adopción del principio de quien contamina paga y/o de las normas considerando las limitaciones con que se enfrentan los gobiernos y los piscicultores en lo relativo a recursos humanos, financiación, acceso a la tecnología, y otras cuestiones.

A discreción suya y si hay tiempo, el GT podría examinar otros puntos que considere importantes.

En cuanto a la redacción de las directrices, el GT podría proponer los tipos de colaboradores que la FAO debería asociar a esta tarea y el tipo de procesos de examen a que habría que someterlas antes de su redacción final y publicación. El GT podría asesorar también sobre el tiempo necesario para esta tarea.

Por último, el GT podría examinar las funciones y los medios de los distintos actores (p.e. gobiernos, industria, piscicultores y sus asociaciones, y organizaciones regionales e internacionales, incluida la FAO) para promover y facilitar la adopción de las directrices.

## GRUPO DE TRABAJO C

## POSIBLE FUNCIÓN Y CONTENIDO DE UN CÓDIGO DE CONDUCTA VOLUNTARIO PARA EL CULTIVO SOSTENIBLE DEL CAMARÓN

## GUÍA PARA EL DEBATE

### Antecedentes

Se están preparando y aplicando cada vez más a nivel nacional e internacional códigos de conducta y códigos de buenas prácticas para lograr que los responsables de las decisiones en los sectores público y privado adopten un comportamiento deseable y previsible. Tales códigos pueden ser el primer paso para la introducción de normas internacionales acordadas internacionalmente o de otros instrumentos jurídicos. Los códigos de aplicación voluntaria por la industria pueden desempeñar una importante función para reducir la necesidad de costosas intervenciones regulatorias de los gobiernos mediante, por ejemplo, medidas preceptivas y de control. Es sabido que la seguridad de los consumidores y de intermediarios como los mayoristas y minoristas, con respecto a la ausencia de impactos ambientales adversos y al respeto de los derechos humanos y las normas laborales en la producción de un artículo, tiene el potencial de incrementar la demanda de tales productos en los mercados internacional y nacionales.

Un código de conducta o un código de prácticas pueden ser eficaces si los gobiernos, la industria y otras partes interesadas, como los consumidores, se sienten comprometidos en el logro de sus objetivos y tienen la voluntad y los medios de aplicarlos y cumplirlos efectivamente. Una de las funciones fundamentales de un código es la de coordinar el comportamiento o las políticas de quienes adoptan las decisiones, ya sean productores individuales, cooperativas o gobiernos. Acordando comportarse en una determinada manera, pueden resolverse problemas comunes como, por ejemplo, el mantenimiento de la calidad del agua dentro de masas de agua comunes utilizadas por varios piscicultores. Si cada piscicultor intenta, por ejemplo, reducir al mínimo los costos del tratamiento del agua y, para ello, descarga efluentes sin tratar en una masa de agua común, es probable que la calidad del agua empeore progresivamente y todos los productores padezcan las consecuencias económicas de las pérdidas de producción al no alcanzarse el crecimiento óptimo o al producirse brotes de enfermedades.

Un código puede asegurar también a los consumidores que determinados atributos negativos que han solido asociarse a un determinado tipo de producto no se dan en los que adquieren de productores o minoristas que cumplen las disposiciones del código.

### Resultados previstos

El Grupo de Trabajo (GT) podría examinar en primer lugar el ámbito de aplicación y las posibles oportunidades y limitaciones de las disposiciones del Artículo 9 “Desarrollo de la acuicultura” del Código de Conducta para la Pesca Responsable (CCPR) aplicadas al cultivo del camarón. Tales disposiciones, así como la mayoría de las demás del CCPR, se dirigen más a los estados que a las industrias o consumidores. El GT podría adoptar la opinión de que la debida aplicación por parte de los estados de las disposiciones del CCPR sobre acuicultura al cultivo costero del camarón podría regular suficientemente la función que deberían desempeñar los estados y gobiernos.

Por otra parte, el GT podría concluir que, además del Artículo 9 del CCPR, es necesario elaborar un código complementario dedicado específicamente a regular el comportamiento y las prácticas de los productores de camarón y, posiblemente también, de otros interesados como los productores de piensos, semillas, productos químicos, etc., elaboradores de productos de camarón, mayoristas y minoristas, grupos ecológicos, organizaciones de consumidores y otros. A este respecto, se plantean las siguientes **cuestiones generales**:

- ¿Cuáles deberían ser los objetivos principales del código complementario y qué cuestiones debería afrontar? A este respecto, el GT podría establecer una diferencia entre el establecimiento de nuevas granjas camaroneras y las que funcionan ya.
- ¿Cuáles deberían ser las funciones y responsabilidades de los productores (granjeros/propietarios de granjas), abastecedores de insumos (fabricantes/abastecedores de semillas, piensos/fertilizantes, productos químicos, equipo, etc.) y empresas/personas que intervienen en la elaboración, distribución y comercialización del camarón (incluidos exportadores, importadores, minoristas, supermecados y cadenas de restaurantes) y consumidores de camarón?
- ¿Cómo pueden reflejarse en el código las diferencias geográficas, sociales, económicas y de otro tipo?

- ¿Cómo se tratarán en el código las externalidades (por ejemplo, la contaminación del agua) impuestas al sector del cultivo del camarón por otros sectores?
- Debería ser el código globalmente aplicable a todas las regiones y estados; o debería aplicarse a nivel regional, teniendo en cuenta las particulares situaciones de cada región?
- ¿Cómo debería elaborarse el código, qué grupos deberían participar en su elaboración y cuál sería el período razonable necesario para su preparación?
- ¿Quién sufragaría los costos del desarrollo y de la aplicación de dicho código? Podría intensificarse la aceptación de dicho código a través de medidas y medios para facilitar o acelerar la aplicación.
- ¿Quién debería encargarse del seguimiento de la adopción y cumplimiento de las disposiciones del código?
- ¿Cómo debería evaluarse el código en lo relativo a su eficacia y a su flexibilidad para ajustarse a nuevos problemas?
- ¿Cuál debería ser la relación entre este código y el CCPR?

El GT podría examinar también si hay aspectos del cultivo del camarón que no deberían regularse mediante un código voluntario sino ser objeto de sistemas de reglamentación más formales. El GT podría estudiar también las condiciones de una región o país que puedan favorecer la eficacia de un código y la forma en que un código puede contribuir a influir en dichas condiciones de manera positiva.

Es preciso estudiar atentamente el tiempo y los fondos necesarios para la elaboración de un código complementario u otros instrumentos y su **aplicabilidad práctica**. Con respecto a esto último, el GT podría prestar atención a varias cuestiones:

- Las dificultades técnicas y los costos económicos relacionados con el establecimiento y seguimiento de los criterios ambientales, económicos y sociales o normas de sostenibilidad que se desean, y los costos de realización de tales evaluaciones.
- Las necesidades especiales de los países en desarrollo en lo relativo a recursos financieros y humanos y capacidad institucional para la aplicación de un código u otros instrumentos (sobre este punto, véase el Artículo 5 del CCPR).
- Las dificultades especiales de aplicación previstas en situaciones en que un gran número de productores en pequeña escala participan en la producción de camarón, como ocurre en muchas partes de Asia. El GT podría examinar las medidas que facilitarían la implementación de un código u otros instrumentos por parte de los pequeños productores de camarón, incluyendo programas de enseñanza y extensión y, posiblemente, también financiación.

El GT debería asesorar acerca de si las directrices previstas sobre políticas para el cultivo sostenible del camarón deben referirse a las necesidades y requisitos para el establecimiento y aplicación de un código de conducta especial u otros instrumentos para el cultivo del camarón. En caso afirmativo, el GT debería asesorar sobre cómo deben prepararse las secciones del código o de otros instrumentos.

Alternativamente (o complementariamente), el GT podría asesorar sobre la función que puede desempeñar la Secretaría de la FAO, con sujeción a la disponibilidad de fondos, en la elaboración de un código específico u otros instrumentos para el cultivo del camarón.

# PAPERS PRESENTED BY DELEGATES, OBSERVERS AND RESOURCE PERSONS

# TRABAJOS PRESENTADOS POR LOS DELEGADOS, OBERVADORES Y TÉCNICOS Y CIENTÍFICOS INVITADOS

# POLICIES FOR SUSTAINABLE SHRIMP CULTURE IN BANGLADESH

by

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## 1. BACKGROUND

Shrimp is considered as one of the most delicious food items among aquatic products and there is a trend of its increasing demand in the world market at the rate of 3-4% per annum. Only few years ago shrimp production was nearly exclusively dependent on wild stocks, but now 18-20% of total quantity is produced from aquaculture. Due to a number of factors, production from wild stocks is declining, so efforts are being made to increase production from aquaculture with adaptation of improved technology.

Bangladesh is bestowed with an extensive coastal area comprising mangrove swamps and huge river deltas. It is estimated that there are approximately 0.2 million ha estuaries and brackish water areas suitable for shrimp farm development. During recent years, a very rapid and remarkable development has been observed in the shrimp farming sector of Bangladesh which contributes about 5% to the global production of cultured shrimp.

## 2. TREND OF SHRIMP CULTURE DEVELOPMENT IN BANGLADESH

In recent years, Bangladesh showed a rapid growth of this sector. Cultured shrimp production increased from 4,000 tons in 1975 to 15,000 tons in 1978 and to about 49,000 tons at present. Shrimp contributes about 11% to the country's total export earnings. Export earnings from shrimp culture increased from Taka 900.8 million in 1981-82 to 3820.5 million in 1988-89 and to about 11,880 million in 1996-97. About 80% of the total marine shrimp production is being exported. With the rapid expansion of the shrimp farming sector, employment opportunities also increased. More than 350 thousand people are engaged directly in different activities of shrimp culture. In addition, about 25-30 thousand people are employed in associated activities such as infrastructure development and the manufacture of equipment, shrimp feed, fertilizer, pharmaceuticals etc. Development and expansion of shrimp culture in coastal areas also helped to improve communication links like roads, water ways etc. The expansion of shrimp culture has led, however, also to the destruction of some mangrove forests, and has resulted in land and social disputes including deterioration of law and order situations in some areas.

Shrimp farming expansion in Bangladesh has taken place mainly through the initiatives of the private sector. Only recently, Government has given priority to this sector because of its high export earnings and also due to the environmental and socio-economic issues that have arisen in the course of its rapid growth.

### 2.1 Shrimp culture area in Bangladesh

During the 1970s, shrimp culture practice was limited to some polders; by cutting the coastal embankments, saline tidal water was allowed to enter the polders along with wild shrimp fry which were reared for 4-5 months. This culture practice began first in the district of Satkhira and later on expanded to other coastal districts of Khulna zone. In Cox's Bazar area shrimp culture initially started in the salt pans during the monsoon months.

At present about 0.12 million ha brackish water area is used for shrimp farming and about 0.02 million ha are under freshwater prawn culture. Out of the total area available for aquaculture in the country, 43% is under brackish water culture.

Systematic shrimp culture practices were started in the 1980s followed by use of feed and fertilizer. Semi-intensive shrimp culture started in a few farms at Cox's Bazar in 1988 and commercial scale production of shrimp post larvae in hatcheries in 1992.

## 2.2 Shrimp culture system in Bangladesh

The different shrimp culture practices observed in the country are the following:

(i) **Mixed culture of** *P.monodon* and various fin fish species is practiced by allowing juveniles of wild stocks to enter polder areas with the tidal waters. In some instances, additional fry of *P.monodon* is also stocked. Predation affects production in this type of system.

(ii) **Mono-culture of** *P.monodon;* pure monoculture is not always possible because of weak management systems and, therefore, this practice is not always suitable.

(iii) **Culture of** *P.monodon* **alternating with paddy**. Shrimp culture takes place from February to mid-August followed by arman paddy culture from mid-August to December. This rotational culture system is excellent if the time schedule for culture can be maintained. But due to non-availability of fry in time, the shrimp culture period is extended causing a delay in the start of the paddy cultivation resulting in lower paddy yields and higher risk of crop loss. Rotational shrimp-paddy cultivation is very common in the southwestern zone of Bangladesh.

(iv) **Culture of** *P.monodon* **alternating with salt.** In this system, mixed culture of *P. monodon* and other shrimp and fin fish species takes place from May to November which is followed by salt production from November until May. This type of practice is very common in Cox's Bazar district.

(v) **Culture of shrimp based on season** is practised during February to middle of August. This system is generally practised in Khulna region and in some parts of Cox's Bazar district and during May to November culture practice is done in the salt production areas of Cox's Bazar.

(vi) **Perennial culture of shrimp** is practiced in some areas of Khulna and Cox's Bazar regions where water salinity is adequate year round.

(vii) **Repeated stocking with simultaneous harvesting** is practised in some shrimp culture systems.

(viii) **One time stocking with periodic harvesting** is considered to be among the most productive shrimp culture systems. Shrimps are harvested after a rearing period of 4-5 months and ponds restocked for another crop provided suitable salinity is available.

(ix) **Culture of shrimp in tidal inundated ponds**. Pumping is required in areas which are not always inundated by tidal waters; this causes additional costs.

(x) **Culture of shrimp without tidal inundation** is practiced in some parts of Satkhira district where ponds are on elevated land. This system requires pumping.

According to stocking density and degree of farm management, the following three basic culture systems can be distinguished:

### 2.2.1 Extensive shrimp culture system

About 75% of the total brackish water area is covered under this system. Extensive culture is practiced mostly in polder areas, often in rotation with paddy cultivation. Farming units are very large (75 ha or above). Polder/pond embankments are irregular, bottom is very uneven and water depth ranges from 6 cm to 1.2 m only. Productivity is low because of irregular water management, absence of drainage canals, predatory animals, and no supply of feed and fertilizer. Stocking rate is 1-2 post larvae per square meter and production ranges from 150-250 kg/ha/year.

### 2.2.2 Improved extensive shrimp culture system

About 25% of the total area is covered under this system. Ponds are medium in size (1-10 ha) and are either rectangular or square in shape. Pond bottom is even and can be drained. Water management and predator control systems exist and some feed and fertilizer are used. Stocking rate is 3-6 post larvae per square meter and production ranges from 200-400 kg/ha/year.

### 2.2.3 Semi-intensive shrimp culture system

In this system, pond size ranges form 0.5 to 2 ha. Pond bottom is even and sloping towards water outlet resulting in good drainage. There exist regular water management and predator control and feeding with pellets. Stocking rates range from 7-15 per square meter but can go as high as 25-60 post larvae. Production ranges from 4-5 ton/ha/crop. Most of the semi-intensive farms produce 2 crops per year. In Bangladesh, no standard procedure is followed for semi-intensive shrimp culture and thus a wide variation is observed in stocking and farm management practices. Only about 700 ha of land in Cox's Bazar and about 300 ha in Khulna regions are under semi-intensive culture.

## 2.3 Input supply and existing facilities for shrimp culture

The main inputs for shrimp culture are seed, feed, fertilizer and equipment. In addition, skilled and experienced technicians are pre-requisites for successful shrimp farming.

### 2.3.1 Seed

It is estimated that about 4000 million post larvae are needed annually for shrimp farming in the country of which only 10-15 million are produced annually in hatcheries. According to a rough estimate about 2000-3000 million post larvae are collected from the wild and the remainder are imported.

Presently, there are 8 *P.monodon* hatcheries in Cox's Bazar of which 4 are technically and physically equipped for production. Hatcheries depend on technical support by foreign experts. Production costs are very high because most of the inputs like artemia have to be imported. Owing to low hatchery production, the shrimp industry continues to depend overwhelmingly on seed from wild stocks.

### 2.3.2 Shrimp feed and fertilizers

With gradual intensification of shrimp culture systems in the country, demand for feed and fertilizer is increasing. The extensive and including the traditional farms covering over 80% of the total area under shrimp culture use locally available feeds like fish meal, mollusc meat, trash fish, by-catches of the behundi net fishery etc. Most of the improved extensive and semi-intensive farms use formulated pellet feeds. At present, there are 3 fish feed factories in the country with a total annual production capacity of 18000 tons.

Both organic fertilizers (cow dung, chicken manure, etc.) and inorganic fertilizers (TSP, Urea etc.) are used in the shrimp farms. These are locally available but other essential components need to be imported.

### 2.3.3 Equipment

Essential equipment for shrimp culture include water and soil testing kits, $p^H$ meter, paddle wheel aerators, Aire $O_2$, battery operated aerators, air blowers, salinometers etc.; these are not locally produced and shrimp farmers are not always familiar with their proper use.

### 2.3.4 Skilled technicians

In the shrimp sector, skilled technicians/labourers are in short supply. Local technicians working on shrimp farms have often no security of service. Some private entrepreneurs have joint ventures with Taiwanese and Thai companies to operate hatcheries and shrimp farms. Some foreign technicians are also employed on payment basis.

### 2.4 Production costs in different shrimp culture systems

Cox's Bazar Area

Production and costs and earnings of semi-intensive shrimp farms in Cox's Bazar area were studied; it was found that production costs per hectare are about Tk 85850 (including depreciation and bank interest). When the production target of 5 tons/ha/crop is reached, net earnings per hectare are estimated at about Tk.398150 in this system at a stocking rate of 15 to 25 post larvae per square meter.

Other than the semi-intensive farms generally most of the farms are of the traditional, extensive and improved extensive types. From field surveys, the average cost and earnings from these three types of culture systems are shown below:

| Type of Culture | Stocking rate per sq.m. | Annual costs/ha Tk | Annual earnings/ha Tk | Average production/ha kg |
|---|---|---|---|---|
| Traditional (lightly managed extensive) | 1.5 | 26250 | 18750 | 150 |
| Extensive | 2 | 23602 | 30500 | 369 |
| Improved Extensive | 2-2.2 | 112090 | 37910 | 500 |

Khulna Area

In the greater Khulna (Khulna, Satkhira and Bagherhat) almost all shrimp culture farms are used in rotation with paddy cultivation. Generally, stocking of shrimp fry starts from January and culture operation continues till July or early August. Paddy plantation starts from mid-August.

In Khulna area there exist in some instances social conflicts between paddy cultivation and shrimp culture. Comparative cost and earnings of paddy cultivation and shrimp culture are shown below:

| Item | Shrimp culture (Tk) | Paddy cultivation (Tk) |
|---|---|---|
| Expenditures | 45,077 | 6,496 |
| Total revenue | 148,200 | 14,820 |
| Net income | 103,123 | 8,324 |

Note : Farm area = 1 ha; Av. production = 500 kg/ha.

There are only very few semi-intensive culture operations in Khulna region which were abandoned after virus infection in 1996.

## 3. ROLE OF SHRIMP CULTURE IN THE NATIONAL ECONOMY

### 3.1 Macro-economic benefits

Fish and shrimp occupy with a share of 7.75% the third position of the country's total export earnings. Of this, about 82% are derived from shrimp exports alone. During the last 5 years, production of shrimp increased by two and a half times. Of the country's total shrimp production, 85% is from coastal aquaculture and the rest from marine capture fisheries. During 1996-97 a total of 25742 tons of shrimp valued at Tk 11889.1 million was exported. Annual production of shrimp (head on) from culture is about 49260 tons. In addition, 15-20,000 tons small shrimp and about 35-40,000 tons of fin fish are also produced in the shrimp farms for local consumption with a total value of about Tk 2200 million.

Shrimp production makes a significant contribution to the country's GDP. Until now, shrimp farming is almost entirely dependent on the supply of local inputs (about 99%). Since 1994-95, a trend has been observed of intensification of farming systems which in future is likely to increase the share of foreign inputs.

### 3.2 Local benefits

Expansion of coastal shrimp farming has created many new employment and income opportunities in rural areas. People living close to canals, rivers and the sea have found employment in shrimp seed collection; a rough estimate indicates that about 0.2 million rural people are involved in this activity. In addition, it is estimated that 0.3 million people are engaged in activities related to shrimp farm construction, operation and management, hatchery operation, harvesting, depot operation, processing, export etc.

Average daily wage rates of labourers are higher when employed in shrimp farms than in freshwater aquaculture farms. Shrimp farming has also created a large number of well-paid skilled jobs in the technical and banking sectors. Govt. agencies are earning revenue from the shrimp farming and from shrimp export.

### 3.3 Institutional and infrastructure development

Both Govt. and NGOs are now actively participating in shrimp culture development, extension, training and demonstration services. Institutional development is also undertaken by Government as well as by Semi-Governmental entities. Infrastructure facilities such as flood protection, dykes, roads, electricity, etc. are gradually developing in the shrimp farming areas.

## 4. IMPACT OF SHRIMP CULTURE ON BIO-DIVERSITY AND COASTAL ENVIRONMENT

Environmental concerns such as aquatic pollution, ecological imbalance, etc. are completely new concepts in Bangladesh. The country is endowed with 687,000 ha of mangrove areas which protect the coast from storm surges and cyclones and provide habitat and nurseries for wild life and fisheries resources. Mangroves play a key role in soil stabilization, nutrient recycling and in maintaining a harmonious food chain in the ecosystem.

Coastal environments are very complex in nature. Owing to limited land space in the country, economic activities in the coastal areas are expanding. The coastal areas have been subject to repeated human interventions to create agricultural land, for salt production, and to utilize forest resources. After 1979, some of the mangrove areas were also converted into shrimp farms.

Shrimp culture practiced in the coastal areas are gradually changing the nature and social environmental patterns generating a number of adverse situations. No doubt shrimp culture generates economic growth, but its sustainability is challenged unless effective and proper planning are undertaken. The coastal environment becomes unbalanced gradually through unplanned and unscientific shrimp farming activities.

### 4.1 Changes in environmental factors

Changes in bio-ecological and physical parameters of both soil and water were recorded by different agencies as a result of shrimp farming:

(i) salt water intrusion for shrimp culture increased soil salinity and soil texture resulting in reduced soil fertility;

(ii) due to continuous farming practice with saline water, salinity increased in tube well water in some areas making it unfit for domestic use;

(iii) continuous discharge of polluted water and black soil into the natural water systems is responsible for unhealthy and polluted conditions;

(iv) continuous water exchange increases siltation affecting rice production.

### 4.2 Effects on marine and coastal resources

(i) The construction of embankments to facilitate shrimp production has resulted in the loss of major capture fish species in the polder areas because natural stock replacement through flooding has been curtailed.
(ii) Coastal areas, especially mangrove forests, are very rich in bio-diversity and support about 330 types of plants and more than 400 species of fish and shrimp including other aquatic fauna. Shrimp seed collection in coastal waters,

canals and rivers affects the biomass of these species. From a careful study it is found that to catch one post larvae of *P.monodon* between 14-21 other shrimp larvae, 21-31 finfish larvae, and zooplankton comprising larvae of other marine and brackish water fauna of about 47-50 different species are being discarded on the shore. Due to improper care during handling and transportation about 70% of the collected shrimp fry suffer mortality.

(iii) Reduction in production and replacement of natural fisheries with potentially more expensive aquaculture.

(iv) Long term potential risk of production loss and productivity decline due to disease, bio-chemical accumulation in soil and ponds and reduced bio-diversity.

(v) Loss of benthic fauna and flora due to prolonged presence of saline water.

### 4.3 Destruction of mangrove forest

The mangrove forest area has been gradually reduced for an expanding shrimp farming sector. This process has started in 1978 and continues till today. About 10,000 ha mangrove forest area in Cox's Bazar district has been converted for shrimp farming. Additional 15-20 thousand ha are occupied for the same purpose. Large-scale deforestation in the Chokoria Sundarban area in the district of Cox's Bazar has begun in 1977 and the entire area of about 20 thousand ha of mangrove trees and shurbs has disappeared due to shrimp culture.

### 4.4 Effect on vegetation and livestock

Introduction of saline water into the protected polders for shrimp culture (embankments were developed by BWDB in the 1960s for improved agriculture) reduced paddy production as well as the production of other agricultural crops. Water salinity has affected the natural environment and permanently eliminated vegetation and trees. Shrimp cultivation in the Khulna region has negatively affected rice production.

The livestock population in the shrimp farming areas has been reduced due to shrinkage of grazing grounds including the areas used to produce animal fodder. Livestock is not only the major source of animal protein in the rural areas but also the source of income for the village people. Expansion of shrimp culture has limited the areas for the development of both the livestock and poultry sectors.

## 5. EFFECT ON RURAL ECONOMY

Shrimp culture expansion has beyond doubt created new job opportunities and trade. More than 0.4 million people are directly employed in the shrimp farms and other related activities such as collection of post larvea; marketing, transportation; depot operation; etc.). In addition, various small industries have been established in rural areas to produce inputs for shrimp farming.

On the other hand, several kinds of multi-purpose common property resources including fishing areas are now under shrimp culture. In some instances, this has left no space even for children to play.

## 6. EFFECT ON SOCIAL ENVIRONMENT

Pollutants and poisonous gases have created health hazards among the people living in the shrimp culture area who suffer from skin disease, diarrhea and malnutrition. Continuous inundation around the houses impede the growing of vegetables and the rearing of domestic animals and birds although these are important additional sources of income for rural people.

### 6.1 Land ownership

Most of the shrimp farms in the Khulna region were established on private rented land. The shrimp farmers have taken the land on lease from the local agriculture farmers on a yearly or long term basis. Sometimes, lands have been occupied for shrimp farming even against the will of the land owners. In some cases, land lease fees have not even been paid regularly to the land owners. This has given rise to many disputes in the locality. After the land has been leased once, some land owners have lost control over their land in the true sense and may have been treated even as trespassers on their own land. With nothing left as the lease fee (about Tk 2000/big/year) which is insufficient to maintain a family, several land owners have had no other alternative than to sell out their properties, domestic animals and ultimately their land.

### 6.2 Contradiction between local and outside labourers

The new employment opportunities created through shrimp culture development have encouraged outside workers to seek jobs on shrimp farms. Shrimp farmers have tended to give preference to employing non-local workers because of their feeling that they are more reliable and loyal than local labourers. This has deprived local people from job opportunities which has in some instances led them to engage in crimes creating acute social problems.

## 7. PROBLEMS IN SHRIMP CULTURE PRACTICES IN BANGLADESH

Some of the major problems associated with shrimp farming in the country are summarized below:

(1) The present farm sites were selected primarily based on land availability and not suitability. Present lands are not always productive having high acid soil. Many sites are at high elevation and located far from the sea limiting tidal water exchange and salinity.

(2) Inadequate infrastructure development and absent or defective flushing and drainage canals which impede proper farm and water management.

(3) Farm ponds are excessively large with no regular shape, uneven bottom, very shallow depth, faulty sluice gates etc. Under these circumstances, it is very difficult to enhance pond productivity in spite of the use of sufficient feed and fertilizers.

(4) A high percentage of shrimp farms operate in rotation on privately owned paddy lands. Due to short term land leases, shrimp farmers do not make adequate long-term investments into pond and water exchange infrastructure for optimal farming operations.

(5) Various kinds of conflicts are commonly associated with the non- payment of lease fees, use of land for agriculture, salt production, mangrove plantation and livestock grazing land.

(6) Industrial pollutants like aluminum, zinc, copper, cadmium, chlorine etc. including use of pesticides for crop protection cause hazards in shrimp farming.

(7) Timely supply of shrimp post larvae is not ensured because of insufficient domestic hatchery capacities.

(8) Lack of knowledge and lack of interest to acquire technical knowledge and keep records on farming activities make it difficult to solve problems.

(9) Excessive stocking rates are often applied because insufficient consideration is given to proper farm management facilities

(10) Predation on cultured shrimp and competition with other shrimp species for food and space are serious issues because water screens are rarely used to prevent predators and other wild shrimp and fish from entering into the culture ponds.

(11) Inadequate domestic supply of formulated feed and other essential inputs.

(12) Shrimp culture in the coastal areas of Bangladesh is a high-risk venture because of frequent cyclone and tidal bores. No cyclone shelter centres have been constructed in the shrimp farming areas discouraging farmers to live at the farm sites.

(13) Security problem is a common feature in shrimp farming areas because no systems exist for the protection of life and property.

(14) No insurance coverage has so far been introduced for the shrimp farming sector.

(15) Credit system is very complicated and difficult to access.

(16) At present there is no regulatory policy in place which can guide the orderly and smooth growth of the shrimp farming sector. Also there exist no functional management committees in the shrimp farming areas to provide definite and positive guidelines on shrimp farming.

## 8. SCOPE OF ENVIRONMENT FRIENDLY SHRIMP CULTURE DEVELOPMENT

Shrimp health hazard is the main cause of concern in recent years. Shrimp farmers and concerned people are now better aware of the environmental effects of shrimp farming activities and have realised the importance of environment protection for the sake of sustainable shrimp production. Some countries have developed high tech intensive shrimp farming but not achieved sustainable production because of environmental hazards. In some instances, the affected shrimp farming areas had to be abandoned in spite of huge investments incurred for infrastructure development.

The position of Bangladesh in this respect is still far better because shrimp farming practices are nearly exclusively of the extensive type. Therefore, the country is known for producing shrimp largely under natural conditions without intensive use of chemicals and specialised feeds.

### 8.1 Adaptation of appropriate and sustainable shrimp farming technology for Bangladesh

Several shrimp farming techniques have already been tested for the country. Considering the country's socio-economic environment and technological adaptability and capability, Bangladesh should adopt its own technology which ensures low risk and low capital investment and high employment generation, and which does not change land quality in a way that negatively affects other crops.

Considering the above factors, the improved extensive type of shrimp farming system should be promoted in Bangladesh. Production of shrimp in the extensive farms can be increased through slight improvements of the present culture system. Bangladesh should gradually adopt a suitable and appropriate technology for shrimp farming which can ensure sustainable optimum production of shrimp without interference with the natural and social environments.

### 8.2 Scope for development of support services

Shrimp farming depends on several support industries such as: (a) shrimp hatcheries; (b) shrimp feed industry; (c) supply of machinery, equipment, chemicals and fertilizers etc. which are at the early stage of development in the country. As shrimp farming further develops on a sustained basis, there is the possibility for further development of these industries.

Important support services and facilities relate to infrastructure development for better water management, prevention of water pollution and avoidance of unwanted animals in the ponds. Water supply and drainage canals should be designed and maintained to allow for natural flow. Other essential infrastructure requirements include (a) communication, (b) supply of electricity, (c) marketing etc.

### 8.3 Shrimp culture management committees

At present, a number of shrimp culture committees exist in the farming area but are not functional under current conditions. Therefore, a newly structured "Shrimp Resource Development and Management Committee" with specific terms of reference and responsibilities has been proposed to be established at the three administrative levels: Thana, District and Division. The main task of the committee is to take care of the environmental and social issues related to shrimp farming. Without recommended approval by the Shrimp Resource Development and Management Committee (at Thana level), no one will be allowed to undertake shrimp farming.

### 8.4 Associations and their roles for shrimp culture management and development

There are national, regional and local shrimp farmers' associations. The associations perform mainly the following activities:

(i) Advise Government on various aspects of shrimp culture development planning.
(ii) Resolve local litigations between shrimp farmers and local people.
(iii) Convey the problems faced by shrimp farmers to the Government as well as to the District and Thana administrations.
(iv) Provide logistic support to shrimp farmers on all matters including marketing of shrimp.

The activities and participation of the associations in the development of the national shrimp industry are not adequate. There is one very strong and able association among exporters: Bangladesh Frozen Food Export Association, that participates effectively and regularly at the national level.

## 9. POLICY RECOMMENDATIONS FOR SHRIMP FARMING

Shrimp culture has negative impacts on the environment because of unplanned and unscientific culture practices. Maximum national and local benefits can be obtained through proper policies and planning ensuring sustainable environment-friendly shrimp farming development. Some of the recommendations which will be useful for expansion of the sector as well as for sustainable shrimp production are as follows:

(i) A national policy should be adopted for proper use of lands in the coastal area considering administrative, technical, economical and social problems. Selection of land for shrimp farming to be done without creation of any public nuisance.

(ii) For shrimp farming either the land owners themselves can use their lands or they can lease out lands on a long term basis at the lease value to be fixed by the recognised committee.

(iii) There should be definite guidelines for use of the resources of brackishwater area for culture of marine and freshwater shrimp including other suitable species of shrimp and fish. Criteria for site selection should include topography, tide fluctuations, salinity, soil quality to produce shrimp, prawn, paddy or salt with suitable adjustments.

(iv) The most suitable and sustainable culture system in the Bangladesh situation (preferably improved extensive system) should be introduced. Culture system is adjustable according to the nature of land and water quality.

(v) The existing shrimp farms, specifically those located in the southwestern zone occupy huge land areas. Farm areas should be reduced to suitable localities only.

(vi) Horizontal expansion of shrimp farming is responsible for indiscriminate destruction of mangrove forests and occupation of more and more paddy fields.

(vii) The collection, handling, transportation and marketing of fry from the wild should be brought under rigid regulation in order to reduce mortality of shrimp fry and ensure by-catch survival. The dependency on wild stocks should be reduced by gradual development of hatcheries.

(viii) Trawlers contribute only about 3.5% of total shrimp production and they catch mainly the matured and gravid shrimp (*P.monodon*). Shrimp catch by trawlers if restricted will help increase supply of broods for hatcheries and also help enhance recruitment in the sea by breeding.

(ix) A green belt of mangroves should be developed along the peripheral embankments to maintain natural environments as far as possible.

(x) Pollution of coastal zone should be reduced due to discharge of industrial effluents, oil and other chemicals by commercial vessels and ship breaking industries. Use of chemicals and medicines to control shrimp disease should be discouraged as far as possible. All harmful activities should be prohibited by law.

(xi) The Government has declared the fishery sector as an “Industry” including aquaculture. Under this programme loan disbursement system is 70-80% as project loan as against 20-30% collateral. Still the loan disbursement is complicated. There should be a strictly supervised credit system integrating the whole process from production to marketing in order to meet the huge investment requirements for shrimp farming.

(xii) A number of departments and organisations have their own programmes in the shrimp farming areas. There should be a separate coastal area management scheme or joint coordinating programme. In their absence, in many instances serious coordination problems arise affecting shrimp farming practices. The programme should include development of common facilities such as road, electricity, canals, sluice gates, dykes etc.

(xiii) At present there is no licensing system in the shrimp farming industry. In order to mange and control the activities and keep them in the right tract, licensing system should be introduced.

(xiv) To make the shrimp farming industry viable scientifically, environmentally, economically and socially, policy guidelines should be developed on the basis of open discussion with shrimp farmers, hatchery operators, processors, governmental agencies and semi-governmental organisations, scientists and field workers.

(xv) Law and order situations in the shrimp farming areas are very adverse, especially during the harvesting seasons. Active surveillance by the law enforcing agencies may improve the situation.

(xvi) There should be a policy decision to persuade farmers to follow the international rules in respect of use of inputs in the culture ponds, post harvest care including other environmental issues.

(xvii) There is not enough legal support in fisheries development and management including quality assurance of fish and fish products. There is no Fish Landing and Marketing Ordinance or Act to cover the problems associated with fisheries activities in these fields. The Marine Fisheries Ordinance (1983) is the only legal support for management, development and conservation of marine fisheries resources. This Ordinance does not cover all the legal issues associated with shrimp culture and quality control. An ordinance has to be introduced covering the existing issues including modification of the 1983 Ordinance for marine fisheries and quality control and new issues related to integrated coastal zone management.

There is no price policy adopted either by the government or the private entrepreneurs or by the trade associations. Under this situation the price of shrimp is dictated or influenced by the supply and demand situations.

(i) Trained manpower on the right system of shrimp farming should be developed both in the public and private sectors.

(ii) Research findings to develop and protect the shrimp industry are already being obtained from different countries of the world. These findings should be used with appropriate modifications and adjustments to the local situations. National research efforts which do not benefit the sector should not be allowed to continue.

## 10. CONCLUSION

Bangladesh is endowed with a wide variety of areas along her 480 km long coast line suitable for shrimp farming. The tidal fluctuation in the coastal zone makes different areas suitable for different types of shrimp farming. Given its importance for the generation of foreign exchange earnings, shrimp culture development is very essential. Existing shrimp culture systems have largely developed with insufficient consideration given to the suitability of land and environment. Farms were established either on paddy lands or in some mangrove forest areas resulting in a number of problems in farm management as well as acute social and environmental problems. These problems are now well recognized and the Government is actively considering various steps to address them. The most important ones are to develop a coherent shrimp farming policy in the country and to establish "Shrimp Resource Development and Management Committees" at different administrative, technical and social levels. These committees will ensure that through proper planning and policy measures shrimp culture development will proceed along sustainable lines. As shrimp culture requires large land areas, found mainly in the remote places of the country, a number of organizations, both Govt. and private have to be associated in its further development. There is still inadequate knowledge on proper farming operations and practices among the people involved in shrimp farming. This needs to be addressed through massive motivational and extension programmes.

| Year | Production | | Export | |
|---|---|---|---|---|
| | Shrimp Farm | Total | Quantity (mt.) | Value (crore Tk.) |
| 1991-92 | 20335 | 86877 | 13730 | 455.73 |
| 1992-93 | 23530 | 125731 | 26425 | 509.60 |
| 1993-94 | 28302 | 100542 | 22045 | 787.73 |
| 1994-95 | 34030 | 113366 | 26277 | 1045.67 |
| 1995-96 | 49260 | 121000 | 25225 | 1106.39 |
| 1996-97 | Not yet available | | 25472 | 1188.91 |

| Activities | Employment | | | | Remarks |
|---|---|---|---|---|---|
| | Males | Females | Children | Total | |
| Farm Construction | 180000 | 20000 | - | 20000 | Seasonal |
| Culture Management | 40000 | - | - | 40000 | Permanent |
| Seed Collection | 60000 | 80000 | 60000 | 200000 | - |
| Seed Trading | 20000 | - | - | 20000 | - |
| Shrimp Trading | 40000 | - | - | 40000 | Middle men |
| Culture input supply | 2000 | - | - | 2000 | - |
| Processing and Export | 2000 | 4000 | - | 6000 | |
| Total | 344000 | 104000 | 60000 | 508000 | |

# CHINA'S AQUACULTURE OF PRAWN: ITS DEVELOPMENT AND PROSPECTS

by

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The recent two decades have seen the rapid development of China's aquaculture sector whose production increased from 1.37 million tons in 1977 (FAO statistics, the same below) to 17.71 million tons in 1996, representing about 60% of the world total production from aquaculture. There is a wide variety of species cultured in China and among them, prawn is an important one. Prawn culture started in the 1970s on a trial basis and entered a stage of all-round development in the 1980s with an accumulated state investment of over Yuan 4 billion, of which, more than Yuan 1 billion was invested by farmers. In the early 1990s, China's prawn production from aquaculture recorded the highest level in history, reaching 220,000 tons valued at over Yuan 4 billion with annual export earnings of US$500-700 million. Meanwhile, with nearly one million people engaged in prawn culture and related industries, it became a main growth factor for economic development in coastal areas. In the late 1980s, diseases of cultured prawn occurred.

## I. REVIEW OF CHINA'S DEVELOPMENT OF PRAWN CULTURE

The history of China's development of prawn culture may be roughly divided into four stages:

### 1. Initial stage (before 1959)

There is a long history of prawn culture in China. However, prawn culture in early years had always relied on using natural larvae and mainly adopted the practice of "dyke enclosure culture", i.e. the polyculture of fish and prawn relying on natural larvae generally without feeding, fertilization and pond cleaning. It was absolutely a practice of extensive culture with a very low average production of only 70 kg/ha. At the time, prawn culture had not yet drawn people's attention.

### 2. Stage of slow development (1959-1981)

Experiments and research on artificial culture of prawn started in China in 1958 and success was achieved in artificial hatching of prawn in 1959, raising the curtain on artificial breeding of prawn larvae. In the 1960s and 1970s, constrained by the lack of successful large-scale commercial larval breeding technology, the expansion of prawn culture was extremely slow despite some new developments. During this period, in addition to Penaeus chinensis, aquaculture research and production units in China made experiments on pond culture and artificial breeding of P. penicillatus, P. merguiensis and P. monodon. With the progress in the experiments, prawn culture came to attract people's attention while aquaculture development was encouraged by the State. In 1978, the area of prawn culture in China was only 1,400 ha with an output of only 450 tons but it expanded to 13,800 ha and 3,682 tons in 1981.

### 3. Stage of rapid development (1982-1992)

In 1980, in order to further promote the development of China's shrimp/prawn aquaculture, the Chinese government paid special attention to the development of prawn aquaculture and set up a leading group on the technology for industrial prawn seed culture, which was responsible for the coordination of technical forces from related research, education and production institutions. It took three years for them to reach breakthroughs in such key technology as parent rearing, nursery water treatment, environmental control of water quality and feed culture, development of hatchery facilities and technology such as breeding rooms, breeders' ponds, nursery ponds, feed tanks and temperature control, air generation and water treatment facilities. These breakthroughs firmly established industrial prawn seed culture with Chinese characteristics. The larval yield per cubic meter of water body increased continuously, normally at 100,000 and up to over 400,000, thus enabling China to become the country with the highest yield.

### 4. Stage of stagnation (since 1993)

In 1993, an outbreak of viral diseases occurred on a large scale in China, which caused the death of large quantities of cultured prawns and the total loss of harvest of numerous prawn ponds. The total prawn production from aquaculture declined to 70,000 tons. The direct economic losses totalled more than Yuan 1.4 billion and indirect economic losses amounted to over Yuan 3 billion. Most of the enterprises and individuals engaged in aquaculture faced deficits. Thus, China's prawn aquaculture suffered a heavy blow. Although the Chinese government has mobilized financial resources and research forces to tackle the problem and gave policy support in terms of loans, land contracting fees, taxes, etc., China's prawn aquaculture has remained in an awkward predicament. At present, the area of prawn culture is basically stabilized in China with production stagnating between 60,000-90,000 tons, reflecting a decline in the yield per unit area.

## II. CURRENT SITUATION OF PRAWN CULTURE IN CHINA

### 1. Existing problems

The biggest problem faced by China's prawn culture sector is the more than 30 kinds of prawn diseases, including virus diseases, bacterial diseases and parasitic diseases. There are multiple factors for prawn diseases, and from an objective view point, the severity of these diseases is the attendant phenomenon, as also observed in foreign countries, of the fast development of prawn production. Due to the expansion of the scale of production and increased intensification, pollution problems have aggravated and led to profound changes in the oceanic environment. To make matters worse, the resistance of prawns has declined making them more susceptible to different pathogens. The primary reasons for the spread and outbreaks of prawn diseases in recent years are as follows:

1) Imperfect facilities and low-standard ponds. Prawn farmers were seriously short-sighted and did not at all or inadequately maintain the ponds resulting in degradation and serious siltation. In areas where prawn culture first developed, there is a high percentage of oversized ponds of 6 ha and more which have rectangular shapes with a length-width ratio of 4-8:1. Moreover, in the period of rapid development too little attention was given to proper siting and density of ponds. This has among other problems led to a situation where there is no strict separation of water inflow and outflow channels. This has made it difficult to control water quality in intensive and semi-intensive farms affecting yields and facilitating outbreaks of diseases.

2) Continuos deterioration of environment and aggravating water pollution have affected the development of prawn farming. The sources of pollution include waste water from industrial and agricultural production, domestic sewage from cities and waste water from the prawn culture industry itself. Moreover, the performance of some farmers does not conform to technical specifications: they give too much inferior feed to prawns and seldom undertake the essential dredging and disinfecting of ponds; this has caused self-pollution of the cultivation environment.

3) Lack of science and standardization in prawn culture. During the rapid development of prawn culture, the short-sighted focus on quick economic returns has led to sub-standard culture practices. While much more attention should have been given to disease prevention, farmers in these areas were insufficiently aware of disease problems nor did they pay sufficient attention to the rational distribution of farming sites and the protection of the ecological balance. Frequently, farming densities went beyond the carrying capacity of the environment resulting in ecological imbalance. Moreover, inappropriate farming practices were applied such as the use of unhealthy prawn larvae, overuse of inferior feed, improper water quality management and random emission and disposal of cultivation wastes.

4) Low popularization of integrated disease control techniques and insufficient technical training for prawn farmers. The establishment of a disease control system in China's prawn culture is still in its early stage. In order to conduct effective supervision, administration and implementation, there is an urgency to establish appropriate standards and legislation for the following: prawn seed rearing; the transfer, introduction and quarantine requirements for domestic and exotic shrimp species; feed quality; and health management including the use of drugs. Furthermore, efforts need to be made in providing technical guidance for disease control, techniques of diagnosis and treatment, information service and other social services which are closely related to production, such as monitoring of water quality and the environment, and forecast of diseases.

## 2. Favourable conditions for the rehabilitation and development of China's prawn culture

The conditions are generally favourable for the rehabilitation and future development of China's prawn culture. Some of the most important areas which need to be addressed are discussed below:

### 1) Infrastructure facilities for prawn culture

According to incomplete statistics, the national capital investment into prawn culture including hatcheries, farms, feed production, and prawn processing and storage is over Yuan 10 billion, and has thus reached a significant scale. The production capacity for prawn larvae is over hundred billion per annum while the annual output of compound prawn feed is over 300,000 tons, and the cold storage and processing capacity has reached tens of thousands of tons. The supporting facilities therefore are adequate.

### 2) Research development on the integrated control of prawn diseases

Looking far and wide at the development of the prawn industry in China, one may find that technical advancement has played a very important role, and experience has been accumulated in the field of prawn hatcheries, cultivation and overwintering. With regard to seed, large-scale hatchery production with stable and high output has been achieved. The research, extension and application of micro-encapsulated diet and micro-pallet diet for prawn larvae were successful. In terms of cultivation, the Technical Specifications on Chinese Prawn Cultivation were formulated and further perfected. The following techniques have been extensively applied in prawn production: techniques on large-scale semi-intensive culture, biofeed cultivation in prawn ponds, cultivation in imitative ecosystem, integrated utilization of prawn ponds and treatment of semi-enclosed pond water.

After the outbreak of prawn diseases in 1993, the research staff in our country have made further studies in the light of the outbreak of epidemic diseases and isolated major pathogens. The major transmission routes and vectors as well as some of the inducing factors have been identified, main measures for healthy cultivation of prawn have been proposed and several methods for quick diagnosis learned and applied in production.

### 3) A professional team of scientific researchers and production managers

After the development in the past two decades, one million people have been involved in prawn cultivation and production and the related industries such as feed processing, cold storage and processing, export, transportation and marketing. Professional staff at various management levels for aquatic production, namely national level, provincial level, city level as well as county level in coastal areas, are responsible for marine culture. In the sector of management of prawn culture, a team of high-level scientific researchers has been created drawing upon staff from research institutes and universities which are subordinated to the Ministry of Agriculture, the Chinese Academy of Sciences, the State Education Commission and the State Oceanic Administration. The extension network for aquaculture techniques has been set up at the level of country, province, city, county and even key townships.

### 4) Current establishment of disease control system in China's aquaculture sector

The national network of disease control in aquaculture has been basically set up and put into utilization. So far, the secondary network of disease control has been set up in 27 provinces, autonomous regions, municipalities and cities listed independently in the state plan while the tertiary and quaternary networks are established in some provinces and cities. The national network members include Fisheries College of Shanghai University of Fishery Sciences, Yellow Sea Fisheries Institute of the Chinese Academy of Fishery Sciences, the Department of Aquatic Production of the Southwest Agricultural University and other institutes and universities. Further striking efforts have been made in the research works on aquaculture diseases as well as in the technical training within the network. The national network of disease control in aquaculture has become a comprehensive cross-sectoral, multi-disciplinary and multi-level organization with large member coverage, smooth flow of information exchange and effective coordination.

In recent years, 18 centres for aquaculture disease control have been set up with national investment of Yuan 15 million and local investment of over Yuan 10 million. These centres are equipped with modern scientific instruments in order to strengthen larva cultivation, variety introduction from domestic and foreign sources, quarantine, and management of feed and chemicals.

5) Emergence of typical examples of large scale healthy cultivation with high yield, high economic returns and improved experience and measures of disease control

In recent times, while the country suffered from the attack of prawn diseases, a large number of typical examples of large scale healthy cultivation with high yield and high economic returns has sprung up. The Project of demonstration zones for integrated control of prawn diseases has been launched by the Ministry of Agriculture in 1995 aiming at finding and popularizing integrated disease control techniques through trials and production practices. The initial success of the Project is indicated by the following: the average yield per hectare was over 2,250 kg in 3 demonstration zones in 1995 with economic returns ranging from Yuan 45,000 to 90,000 per hectare. In 1996, 20 demonstration zones of prawn disease control were established in 16 coastal provinces and municipalities with a total area of 460 hectares. The average yield per hectare was 1,650 kg with average economic benefits of Yuan 52,500 per hectare. In 5 demonstration zones, the average yield per hectare was over 2,250 kg with benefits ranging from Yuan 45,000 to 150,000.

## III. CHINESE POLICIES ON PRAWN CULTURE

### 1. Delegate production and management responsibility and promote the coexistence of diversified operations with household-based contractual management as the main form

The "Law of Fisheries of the People's Republic of China" provides that waters and mud flats suitable for aquaculture production may be designated by local governments above the county level, in accordance with the nation's unified arrangement for the utilization of waters, to state-owned units or units of collective ownership for their aquaculture operations. Certificates of use for aquaculture operations shall be issued and the right of use shall be authorized. The above-mentioned waters and mud flats may be contracted by individuals for aquaculture production. The State encourages trans-regional, multi-sectoral and multi-ownership operations by engaging in technical contracts and setting up solely- or jointly-funded enterprises. The State also facilitates the rational flow of labour, capital, technology and other production factors and their optimal use so as to fully mobilize producers' initiatives.

### 2. Adopt supporting policies and increase inputs through multiple channels

Aquaculture is a major sector to which the State grants preferential treatment in support of its development. The sector is categorized as an industry with policy-oriented investment benefiting from greater financial inputs and preferential interest rates. Aquaculture is given priority in receiving foreign capital investments. Moreover, local governments at various levels have, in order to encourage farmers' initiatives, adopted tax exemptions and preferential tax rates, and carried out appropriate exemptions and reductions of value-added tax and other fees. In some areas, even the prawn pond contract fee has been reduced or exempted so as to protect farmers' interests, enhance their disease-resistance capacity and promote the development of prawn culture.

### 3. Protect the aquatic environment and enhance aquaculture production

For over a dozen years, under the leadership of government authorities responsible for environment protection, the fishery supervision and administration departments at various levels have strengthened the management of the aquatic environment. Dozens of fishery environment monitoring stations have been established while laws and regulations concerning fishery environmental protection have been formulated or improved. Close collaboration has taken place between the fisheries agencies and environmental protection departments to conduct environmental assessments and inspections of newly established projects in shallow waters and mud flats, in order to effectively control potential sources of pollution. The fishery environmental monitoring stations are in charge of water quality control and, when finding any possible danger of contamination, give timely reports to relevant authorities in order to effectively prevent or alleviate harm to fisheries. In the meantime, great efforts have been made to control the pollution induced by aquaculture itself. Research has been carried out on the maximum stocking capacity of shallow waters and mud flats so as to prevent overstocking in prawn ponds. Research has also been undertaken to suit production techniques to local conditions, improve farm design and engineering and to protect the aquatic environment.

### 4. Make innovations in management and technical operations

Due to the outbreak of shrimp diseases, many countries and areas in the world have made corresponding adjustments in development strategies, operational policies, models of shrimp culture and technical standards and measures. So far, there have been many successful stories which indicate that higher efficiency in resource utilization in combination with environment protection is the right way to carry out high-yield prawn production. China has a very long coastline, with prawn ponds covering 11 provinces, autonomous regions and municipalities. However, in the best year of harvest, the average per hectare production was only 1500 kg. Therefore, the future development of prawn culture lies in innovations in management and technical operations which allow for the gradual change from the "extensive and low-yielding" to the "intensive and high-yielding" production mode.

## IV. MEASURES FOR THE SUSTAINABLE DEVELOPMENT OF PRAWN CULTURE IN CHINA

### 1. Actively carry out sound prawn culture

Disease prevention should be given the first priority and attention should be given to the principle of sound culture to achieve stable and sustainable production. Although efforts for sound culture can require significant labour and other inputs and may well face great difficulties, it is suggested that this approach be followed based on methods which integrate various technical measures for disease prevention including the following:

1) Rational stocking density and larger size of prawn seed. Improve the multi-stage sterilization of parent prawns and water for larval rearing, and live animal feed organisms. Avoid both high temperature breeding and abuse of antibiotics taking into account standards for breeding of young prawn. The quality of young prawn for sale must be tested thoroughly.

2) Insist on good silt cleaning and sterilization of prawn ponds, water-inlet channels and water storage ponds. Cut off disease sources, in order to create a clean and sound environment for the growth of prawn.

3) Pay attention to nutrition and feed demand of prawn and strengthen the culture of the live animal feed organisms in prawn ponds. The culture of live animal feed organisms should be timed well with silt cleaning and sterilization for prawn ponds. At the same time, the use of artificial feed of good quality is encouraged.

4) Maintain a good and stable water environment. Recognize the importance and the function of storage ponds and aerators. Encourage the application of photosynthetic bacteria or environmental protectants (lime, calcium peroxide, zeolite, etc.). Strengthen measures for the adjustment and control for water colour, and ensure application of useful algae as superior varieties. Pay attention to technical measures for storm prevention and ensure a stable water environment so as to control adverse effects on prawns.

5) Rational mixed culture and multi-species prawn culture. The mixed culture utilizing prawn as its mainstay is encouraged so as to be favourable for the control of prawn diseases and to promote the balance of micro-ecology in pond. When properly combined with fish and crabs, it can also control or reduce the spread of prawn diseases and help preventing disease outbreaks.

6) Rational distribution. In order to protect primary productive forces and to safeguard ecological environment, sea areas with large density of stocking should be rationally readjusted in order to prevent self-pollution in those areas.

It is strongly emphasized that, to achieve full success in controlling virus diseases of prawn, it is crucial that not only one or several specific technical measures are applied, but that integrated prevention measures are also carried out throughout the whole culture technology. Each stage of culture should be linked and coordinated with the other.

### 2. Strengthen scientific and technical research and extension, to overcome the most serious difficulties in controlling prawn diseases

In recent years, through the joint research and problem solving efforts by the relevant scientific research institutions, the study on controlling prawn diseases (especially as regards sources and origins of diseases, pathology and transmission patterns of infectious diseases ) has generated useful results and some ideas for quick diagnosis and sound culture have been found.

However, when diseases occur, there are still no techniques for controlling diseases quickly and effectively. Moreover, the study on technology for specific culture and control of live animal feed organisms and algae, and on technology for controlling microecology for prawn pond bottom and the quality of water should be further strengthened. Therefore, it is necessary to continue efforts aiming at: (i) organizing people to solve the technical problems through integrated control of diseases; (ii) increasing input of funds for controlling diseases; (iii) strengthening the system of disease control and the system of technical extension for aquatic production. Applicable technologies and sound culture methods which are proving to be effective in controlling diseases should be disseminated to aquaculture producers.

### 3. The maintenance and improvement of prawn ponds

Most prawn culture in China is based on extensive and semi-intensive production practices. In recent years, great losses resulting from diseases and negligence in pond maintenance and upgrading have caused that most of the prawn ponds could not reach required standards with consequent difficulties in disease control. Therefore, significant efforts, including in particular improvement of pond conditions and silt cleaning, should be carried out in order to increase the water volume and favour intensive and high-yielding production. The following measures are of utmost importance: first, the inlet and outlet water channels should be constructed well, and it should be ensured that irrigation (water supply) is separated from drainage; second, large ponds should be transformed into small ponds and shallow ponds into deep ponds; third, construction of necessary water storage ponds and ponds for sedimentation should be encouraged; fourth, measures to ensure adequate oxygen supply, including the use of aerators should be promoted.

### 4. Improving the legislation and strengthening the management of prawn larvae, feed and fish medicines

Strengthened management of prawn larvae, feed and fish medicines is an important guarantee for preventing the occurrence of diseases. Priority should be given to the following: a) improved supervision of product quality; b) strengthened control and quarantine procedures for the importation of prawn larvae which should be carried out strictly according to the regulations of the "Entry and Exit of Animal and Plant Quarantine Law" which was newly issued; c) strengthened review and approval procedures and combat of illegal importations; and d) better quarantine and isolation for temporary raising. At the same time, quarantine management for introducing new varieties in domestic areas should be worked out and implemented as soon as possible in order to prevent epidemic diseases from spreading quickly throughout the country. Other requirements include the establishment of related quality standards of feed and fish medicines, the proper conduct of production activities according to required standards and their regular monitoring and supervision..

### 5. Strengthening of technical training and international exchange

In the past several years, the technical research departments of many countries and regions of the world have carried out research on prawn diseases. These departments not only have carried out work on theoretical and practical disease control aspects, but have also explored immune mechanisms (SPF and SPR). China is interested in strengthening various forms and channels of exchange and cooperation with other countries and regions on prawn diseases and health management in order to improve prawn culture in China and other parts of the world.

# CARACTERIZACIÓN DE LA ACTIVIDAD CAMARONERA ECUATORIANA

por la

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## INTRODUCCIÓN

Hace treinta años no existía el cultivo de camarones en el Ecuador. El camarón que se exportaba en modestos volúmenes provenía exclusivamente de la pesca en el mar. En 1968 se hicieron los primeros intentos para reproducir esa experiencia en El Oro, pero no fue sino hasta 1977 cuando la acuicultura cobró impulso en el país.

Una década después, el Ecuador es uno de los principales exportadores de camarón en el mundo. Se están cultivando alrededor de 170 000 hectáreas y produciendo 85 650 toneladas netas de camarón entero. Las exportaciones se han cuadruplicado en 10 años, produciendo 624 millones de dólares en 1996. El camarón constituye el 22.5% de las exportaciones privadas y equivale a las dos terceras partes de la Reserva Monetaria Internacional.

En efecto, en la tabla No. 1 se presenta la producción desde su inicio con 4 043 t hasta el año 1996 con 85 650 t. En la tabla No. 2 se presenta la información de la producción de camarón de mar y de criadero donde puede observarse que el 96% de la producción camaronera en el Ecuador proviene del cultivo. La tabla No. 3 demuestra el número total de granjas, su distribución por provincias y por situación geográfica.

### Tabla No. 1

### ECUADOR EXPORTACIONES DE CAMARÓN
### 1979-1997

| Años | t | Miles US$ |
|---|---|---|
| 1979 | 4.043 | 30.596 |
| 1980 | 8.098 | 56.884 |
| 1981 | 11.304 | 77.525 |
| 1982 | 16.507 | 122.348 |
| 1983 | 21.597 | 175.073 |
| 1984 | 21.305 | 159.840 |
| 1985 | 20.044 | 156.486 |
| 1986 | 31.098 | 287.882 |
| 1987 | 48.723 | 383.136 |
| 1988 | 56.211 | 387.047 |
| 1989 | 46.279 | 328.221 |
| 1990 | 52.791 | 340.291 |
| 1991 | 79.029 | 491.371 |
| 1992 | 86.796 | 525.759 |
| 1993 | 72.596 | 451.427 |
| 1994 | 73.408 | 545.835 |
| 1995 | 86.567 | 673.422 |
| 1996 | 85.650 | 624.330 |
| 1997 * | 78.609 | 631.340 |

Enero-Septiembre 1997
Fuente: Banco Central del Ecuador

## Tabla No. 2

## PRODUCCIÓN DE CAMARÓN EN CULTIVO Y DE MAR
1977-1996

| Años | Industrial | Artesanal | Cultivo | Total |
|---|---|---|---|---|
| 1976 | 7.522 | 160 | 1.318 | 9.000 |
| 1977 | 7.047 | 170 | 1.383 | 8.600 |
| 1978 | 6.322 | 178 | 2.700 | 9.200 |
| 1979 | 7.508 | 279 | 4.698 | 12.485 |
| 1980 | 7.470 | 330 | 9.180 | 16.980 |
| 1981 | 7.550 | 450 | 12.100 | 20.100 |
| 1982 | 7.000 | 1.000 | 21.500 | 29.500 |
| 1983 | 8.033 | 867 | 35.700 | 44.600 |
| 1984 | 5.556 | 734 | 33.600 | 39.900 |
| 1985 | 5.343 | 680 | 30.205 | 36.228 |
| 1986 | 7.143 | 1.993 | 43.628 | 52.794 |
| 1987 | 9.442 | 1.288 | 69.153 | 79.883 |
| 1988 | 7.083 | 1.017 | 77.480 | 82.580 |
| 1989 | 6.963 | 677 | 70.063 | 77.703 |
| 1990 | 9.027 | 1.116 | 76.420 | 86.563 |
| 1991 | 12.092 | 1.495 | 112.278 | 125.865 |
| 1992 | 11.368 | 1.407 | 115.151 | 127.946 |
| 1993 | 9.398 | 1.162 | 95.043 | 105.603 |
| 1994 | 9.477 | 1.053 | 94.770 | 105.300 |
| 1995 | 8.919 | 990 | 113.951 | 123.860 |

Fuente: Subsecretaría de Recursos Pesqueros

## Tabla No. 3

## DISTRIBUCIÓN DE GRANJAS CAMARONERAS (1996)

| Provincia | Total granjas | Distribución porcentual | Zonas altas | Zonas de playa |
|---|---|---|---|---|
| GUAYAS | 978 | 49% | 452 | 526 |
| EL ORO | 451 | 22% | 154 | 297 |
| MANABI | 404 | 20% | 209 | 195 |
| ESMERALDAS | 175 | 9% | 95 | 80 |
| TOTAL | 2.008 | 100% | 910 | 1.098 |

Fuente: Subsecretaría de Recursos Pesqueros

### CULTIVO EXTENSIVO

Trabaja con estanques de tierra de superficie variable que se llenan con el agua y las larvas que traen las mareas. La densidad es muy baja. La alimentación del camarón depende completamente de la producción natural de fitoplancton de zooplancton. No se usan alimentos adicionales ni fertilizantes.

Puede haber un intercambio mínimo de agua por medio de bombas. El rendimiento es entre 300 y 900 libras de camarón sin cabeza por hectárea al año.

Esta forma de maricultura puede arrojar rendimientos relativamente satisfactorios cuando existe un manejo apropiado, pero es más común que resulte antieconómica.

## CULTIVO SEMI-EXTENSIVO

Se refieren a las camaroneras con piscinas de diseño definido y con superficies que fluctúan entre 2 y 20 hectáreas. Implica un nivel mayor de tecnología. Las larvas provistas por pescadores o laboratorios, llegan primero a unas piscinas de crecimiento y selección llamadas "precriaderos", donde permanecen varias semanas, de donde luego son trasladados a piscinas para su crianza definitiva. Las instalaciones están equipadas con bombas para la renovación continua del agua. Se usan además fertilizantes y alimentos suplementarios. La densidad del cultivo depende sobre todo de la disponibilidad de "semillas" y del capital del trabajo con que se cuenta.

En nuestro medio se prefiere distribuir las larvas en tantas piscinas como sea posible y no concentrar todo el esfuerzo en menos piscinas con una densidad de población mayor. El rendimiento en esas condiciones es de 900 a 1.300 libras por hectárea y por año.

Este sistema requiere de una inversión relativamente importante de capital, pero también se caracteriza por una tendencia general a mantener los costos de inversión y de operación al nivel más bajo posible. Además incluye la alimentación con alimentos balanceados ya sea en todo el ciclo o en la parte final del ciclo de cultivo.

## CULTIVO SEMI-INTENSIVO

Se practica generalmente en fincas que están integradas verticalmente, haciendo parte de empresas de empacado y exportación . Las larvas provienen del trabajo de los pescadores y de los "laboratorios". Las piscinas de crecimiento reciben niveles altos de alimentos suplementarios y mayores niveles de renovación de agua. Regularmente se lleva un control técnico e interviene el asesoramiento de biólogos expertos. Los rendimientos pueden llegar a las 1.300 y 3.900 libras anuales por hectárea.

## CUANTIFICACIÓN DEL USO: LOS MÉTODOS

La producción camaronera es en gran medida una producción semi-industrial y semi-intensiva. Esto no es necesariamente negativo ya que se ha desarrollado en la medida en que ha progresado el nivel tecnológico camaronero y tienen menor impacto en el ambiente.

A su vez, el cultivo del camarón es una actividad tanto de pequeños como de grandes productores. Se estima que el 60% de los pequeños productores tienen camaroneras de entre 1 y 30 hectáreas. Por falta de financiamiento muchos de ellos no pueden incorporar los avances tecnológicos a sus piscinas.

Los cultivos de tipo semi-intensivo representaron el 46% del total de área camaronera en 1994; se desarrollan en Manabí, Guayas, El Oro y Esmeraldas. Su hectareaje en producción ha aumentado progresivamente desde 1988. Para este tipo de cultivo logró superar el hectareaje del cultivo semi-extensivo.

Los cultivos bajo el sistema semi-extensivo representan el 39% del total de área camaronera y se desarrolla en las cuatro provincias camaroneras. Su hectareaje en producción ocupó el primer puesto hasta 1991 a pesar que venía reduciéndose desde 1988. Como se expresa anteriormente, este tipo de cultivo ha sido superado en hectareaje por el de tipo semi-intensivo y su rendimiento por hectárea ha decrecido también.

Los rendimientos en libras por hectárea varían enormemente de una camaronera a otra y de un año a otro. Al año 1996 el promedio de producción del Ecuador fue 1 461 libras por hectárea de camarón entero con 2 a 2.5 cosechas por año.

## PRODUCCIÓN DE LARVAS

La escasez periódica de larva silvestre que en el pasado ponía en peligro la estabilidad de la producción de las piscinas, se ha ido superando progresivamente desde el año 1981 que se instaló el primer laboratorio de producción de larvas en el país.

Actualmente en el Ecuador existen alrededor de 350 laboratorios para producción de larvas con suficiente capacidad instalada para cubrir todas las necesidades de la industria camaronera ecuatoriana.

Así mismo, de estos 350 laboratorios, 25 poseen infraestructura completa incluyendo cuartos para la maduración del camarón con capacidad de abastecimiento del 50% del requerimiento de nauplios.

Es importante indicar que en los últimos 4 años el criterio de "ciclo cerrado" ha venido tomando fuerza en el país y es así que 4 laboratorios verticalmente integrados (producción y exportación) ya están trabajando con esta tecnología.

Sin embargo, el criterio de que la larva de laboratorio es de menor calidad que la silvestre aún persiste y debe ser superado.

El fomento a la investigación asegura una producción futura de larva de óptima calidad que garantice la actividad camaronera a largo plazo.

Los laboratorios integrados que cubren todas las etapas del ciclo vital del camarón y que a su vez son los que están mejor equipados son los llamados a realizar los trabajos de investigación que se requieren. Además, en la actualidad existen muy pocos laboratorios de éste tipo en el país, debido a su complejidad y a los altos costos de inversión y de funcionamiento.

Debido a la presencia del fenómeno del Niño se ha observado un hecho sin precedentes desde los inicios del cultivo de camarón en el Ecuador con una extraordinaria producción de larvas silvestres lo que se ha reflejado en la significativa baja de precios de este producto.

## PRODUCCIÓN DE ALIMENTOS BALANCEADOS

En Ecuador operan alrededor de 26 fábricas que elaboran diferentes marcas de alimentos para acuicultura.

Se estima un consumo de una a dos libras de alimento balanceado por cada libra de camarón entero cosechado.

Sin embargo, cierta materia prima que forma parte de la dieta del camarón continúa siendo importada aunque existen proyectos que investigan la posibilidad de producirlas en el futuro. La investigación está a cargo de las propias fábricas, de organismos internacionales y la Escuela Politécnica del Litoral (ESPOL).

Con el propósito de contribuir a mejorar la calidad de los alimentos en 1988 se elaboró la "Norma de Requisitos" con la participación del sector público, los productores del camarón y alimentos balanceados. La norma proporciona al sector oficial de un instrumento operativo para exigir el cumplimiento con los requisitos mínimos y máximos para el alimento del camarón.

Sin embargo, el precio del alimento constituye el principal problema para mejorar la calidad del alimento. Las materias primas de origen animal utilizadas en su elaboración (principalmente harina de pescado) tienen un elevado costo y son de difícil adquisición.

El alimento balanceado se produce en rangos de proteína total desde el 20% hasta el 40%, siendo el más requerido el de 28%.

Es importante destacar que las fábricas de alimento balanceado en muchos casos asumen los roles de financistas contribuyendo de esta manera a que el alimento de óptima calidad pueda ser adquirido por pequeños y grandes productores.

En la búsqueda por reducir el costo de los alimentos, se están realizando investigaciones sobre diversos subproductos de la actividad agrícola que podrían servir como fuente de proteína y energía para la actividad acuícola.

## MERCADO INTERNACIONAL.

En el Ecuador, entre enero y septiembre de 1997 han exportado camarón alrededor de 78 empresas exportadoras. Sin embargo, no todas tienen planta propia y algunas realizan copaking en otras plantas que ofrecen este servicio. Actualmente 56 plantas procesadoras de camarón se encuentran en funcionamiento en el país aproximadamente el 70% están ubicadas en la Provincia del Guayas.

Si analizamos la evolución de las exportaciones ecuatorianas de camarón en los últimos diez años, podemos observar que inicialmente se destinaba alrededor del 98% a EE.UU. El sector se propuso diversificar los mercados de destino y actualmente posee tres mercados perfectamente definidos que son Estados Unidos, Europa y Oriente a los que le corresponde el 60,5%, 27% y el 12,4% de las exportaciones respectivamente. Adicionalmente se está comercializando nuestro producto con otros países de América.

Esta diversificación de mercados ha sido acompañada por la diversificación de productos. A la fecha Ecuador ofrece camarón crudo congelado en bloque e IQF, cocido en bloque e IQF, con cabeza, easy-peeled, needle-deveined, pelado, apanado y en presentaciones listos para servir.

Así tenemos que a Estados Unidos se exporta principalmente colas de camarón, camarón entero, pelado y desvenado (P&D), Tail on. Por otro lado, los países europeos importan principalmente camarón con cabeza y en menos porcentaje camarón pelado. Mientras que a Oriente el camarón es enviado entero, pelado y desvenado (P&D) y colas en menos proporción.

## Tabla No. 4

## EXPORTACIONES DE CAMARÓN POR MERCADO DE DESTINO

| Exportaciones cuatorianas de camarón | | |
|---|---|---|
| **Destino** | **Miles de Libras** | **Miles de US$ FOB** |
| EUROPA | 46,932 | 140,523 |
| ESTADOS UNIDOS | 104,904 | 413,359 |
| ORIENTE | 21,466 | 77,459 |

**Nota:** Exportaciones de Enero – Septiembre 1997
**Fuente:** Banco Central del Ecuador. Estadísticas CIA. LTDA

Es importante mencionar que el precio del camarón ecuatoriano es afectado por diferentes factores que corresponden principalmente a variables económicas (variación de la moneda) y productivas (variación en la oferta).

Otro factor que tiene efecto en el precio del camarón ecuatoriano al consumidor es la tarifa aduanera con el cual el camarón entra en el mercado de consumo. En EE.UU., el camarón ecuatoriano importado entra sin pagar derechos y en Europa, Ecuador está favorecido por el sistema general de preferencias y sus camarones pagan menos derechos de aduana que los productos de los principales competidores.

El arancel vigente para el camarón ecuatoriano en los países de la Unión Europea es del 3,6% desde enero de 1997 hasta junio 30 de 1999, el mismo que fue concedido como recompensa por la lucha contra el narcotráfico. Pero por las discrepancias que existen actualmente con la Unión Europea sobre banano y una creciente frustración con las injusticias del Sistema Legal Ecuatoriano hacen probable que al vencer los actuales privilegios no sean renovados con el mismo trato favorable que antes. Esto quiere decir que el camarón ecuatoriano va a costar más a los europeos sin ninguna ventaja al exportador.

El sector acuicultor ecuatoriano esta también exportando interesantes cantidades de tilapia principalmente a EE.UU., Colombia, Europa, y la oferta potencial de Red Claw y de otros productos de cultivo bioacuatico permitirán obtener mayores ingresos al país.

Es importante mencionar que el sector acuicultor y pesquero se encuentran implementando el Sistema HACCP en las plantas procesadoras. La Subsecretaría de Recursos Pesqueros ha realizado un plan de Inspecciones y Evaluaciones a las Plantas y a partir del 1 de febrero de 1998, las que no hayan concluido la implementación y no tengan la correspondiente certificación del Instituto Nacional de Pesca no podrán exportar Productos del Mar a ningún mercado de destino.

## ASPECTOS AMBIENTALES

Una de las principales recursos naturales que el país posee es el ecosistema de manglar, el cual es de gran importancia por confluir en el mismo intereses de toda índole. En las tres últimas décadas, los manglares han sido objeto de uso intensivos provocados principalmente por el crecimiento de centros urbanos sobre áreas de manglar, el uso del recurso en la construcción de casas, edificios, puentes y muelles y por la conversión de manglares a piscinas para la cría de camarón.

En 1995, se efectuó la actualización de la evolución de superficies de manglar, camaroneras y salinas mediante información satelitaria por parte del Centro de Levantamiento de Sensores Remotos CLIRSEN, siendo los resultados los siguientes:

Tabla No. 5

EVOLUCIÓN DE ÁREAS DE MANGLAR, CAMARONERAS Y SALINAS DESDE 1969 A 1995 (en HA.)

| Cobertura | 1969 | 1984 | 1987 | 1991 | 1995 |
|---|---|---|---|---|---|
| MANGLARES | 203.624,80 | 182.157,30 | 175.157,40 | 162.186,55 | 149.570,05 |
| CAMARONERAS | 0 | 89.368,30 | 117.728,70 | 145.998,33 | 178.071,84 |
| SALINAS | 51.752 | 20.022,10 | 12.273,70 | 6.320,87 | 5.109,47 |
| **TOTAL** | **255.376,80** | **291.547,70** | **305.159,80** | **314.505,75** | **332.751,36** |

**Nota:** La disminución de manglar hasta el año 1995 corresponde a un 26% de su totalidad, se estima que la industria camaronera es responsable por el 14% de esta disminución.

En su afán de proteger éste ecosistema, el gobierno ecuatoriano ha implementado una serie de instrumentos legales que van desde la creación de dos Reservas Ecológicas, una en el año de 1979 y otra en 1996 destinadas a proteger alrededor de 60 000 ha. de manglar; en 1985 declaró de interés público la conservación, protección y restauración de los bosques de mangle, en 1995 se expidió el reglamento para la Ordenación, Conservación, Manejo y Aprovechamiento del Manglar, mediante el cual este recurso está fuera del comercio, no es susceptible de posesión o cualquier otro medio de apropiación , entre otras medidas de carácter conservacionista.

A continuación se describen las leyes y reglamentos que el Estado Ecuatoriano ha implementado para la conservación del manglar:

1. Decreto No. 824, Junio 5 de 1985: Declaración de manglares como propiedad pública se prohibe la explotación y la tala.

2. Ley 091, Agosto 7 de 1990: Se declara a los manglares propiedad del Estado incluyendo aquéllos que se encuentran en áreas privadas, no pudiendo comprar ni vender este recurso.

3. Decreto No. 1907, Julio 13 de 1994: Regulaciones adicionales para la protección y conservación de manglares en áreas protegidas.

4. Decreto No. 2157, Octubre 5 de 1994: Creación de la Comisión Mixta para el desarrollo sustentable del Golfo de Guayaquil.

5. Decreto No. 2619, Marzo 30 de 1995: Ratificación Gubernamental para la protección de manglares especialmente los de la provincia de Esmeraldas

6. Decreto No. 2327, Diciembre 22 de 1995: Reglamento para la Conservación, Manejo y Explotación del Manglar.

7. Decreto No. 3519, Febrero 22 de 1996: Conformación del Grupo Interinstitucional para el Manejo Ambiental del Golfo de Guayaquil.

8. Resolución No. 052-A, Marzo 15 de 1996: Creación de la Reserva Ecológica Cayapas-Mataje.

9. Decreto 195-A, Octubre 4 de 1996: Creación del Ministerio de Medio Ambiente.
10. Ley No. 003, Septiembre 27 de 1997: Ley para la protección de la biodiversidad en Ecuador.

Por otro lado, el Estado ecuatoriano con la finalidad de implantar un sistema de manejo de recursos compatible con el desarrollo sustentable, creó el Programa de Manejo de Recursos Costeros quienes están poniendo en práctica cinco estrategias básicas para el manejo de los manglares, que van desde la participación en la toma de decisiones sobre planificación y control de usos del recurso, hasta el establecimiento de Unidades de Control y Vigilancia del manglar, integradas de manera institucional y comunitaria.

Otro aspecto ambiental considerado importante, es el relacionado a la calidad de agua, cuya declinación es atribuida a tres aspectos: descargas de aguas servidas provenientes de centros urbanos sin tratamiento previo, incremento de la carga tóxica de origen agroquímico e industrial y el incremento de nutrientes provenientes de las descargas de las camaroneras. A este respecto el Estado ecuatoriano está llevando a cabo acciones conducentes a implementar sistemas de tratamiento sanitarios que permitan disminuir el impacto generado por la contaminación urbana, como en el caso de Guayaquil, cuyo trabajo esta siendo financiado por el BID, pero que sus efectos podrán medirse en un mediano plazo; sin embargo con respecto a agroquímicos poco esfuerzo se ha realizado al respecto, y en relación a la eutroficación de aguas debido a las descargas de camaroneras, el sector gremial que los agrupa esta recomendando la disminución del uso de fertilizantes, control en las tasas de alimentación y disminución del recambio de agua en las piscinas.

Un tercer aspecto de importancia en materia ambiental es la captura de larvas provenientes de poblaciones naturales y los impactos causados por pesca acompañante, para lo cual el gobierno ha implementado vedas que contribuyan a la protección y manejo de stocks naturales y evitar la sobrepesca de postlarvas, de hembras grávidas y de camarón adulto

## ASPECTOS MACRO-ECONOMICOS DE LA ACTIVIDAD CAMARONERA

En el proceso productivo camaronero, se producen encadenamientos de producción y encadenamientos de mano de obra. Esto quiere decir que una industria importante no podrá desarrollarse, si es que no se desarrolla en forma proporcional y armónica con otras industrias que le ofrecen insumos físicos o servicios. Así por ejemplo, en este sector, no podía haber llegado a la situación actual sin investigación biológica. Es así que en cualquier país, la producción de otras industrias es más importante que la producción para el mercado final en términos monetarios.

Generalmente se valora la importancia macroeconómica en niveles de empleo directos y alguna estimación del indirecto, mientras que la valoración de los incrementos de producción son los que generan un valor agregado sostenido y que finalmente se expresan en empleo e ingresos.

Debido a limitaciones, se exponen algunos elementos cuantitativos de los impactos directos e indirectos y los encadenamientos de producción hacia atrás (industrias que proporcionan insumos) y hacia adelante (industrias, comercios que demandan nuestros productos.

A continuación se presenta un análisis estimativo de este proceso.

## IMPACTOS DIRECTOS

A primera vista se consideran los impactos directos a los generados por la producción de camarón (costos de operación) sin embargo la inversión inicial, es la que más impacta en la economía y en el caso de éste sector, la reinversión. Por lo tanto, los impactos directos tienen tres componentes que serán analizados a continuación:

- Inversión
- Reinversión
- Operación

Las estimaciones se hacen a precios de 1994 y para 140 000 ha.

## COSTOS DE INVERSIÓN

A continuación se estiman los costos de inversión por Ha. a precios de 1994

## COSTOS DE INVERSIÓN POR HA Y TOTAL DE CAMARONERAS

| **Rubros** | **Costo por ha (millones de S/.)** | **Costo Total (millones de S/.)** |
|---|---|---|
| Terreno | 1,2 | 168 000 |
| Estación de Bombeo | 3,1 | 434 000 |
| Compuertas | 0,9 | 126 000 |
| Muros y piscinas | 4,3 | 602 000 |
| Campamentos | 1,8 | 252 000 |
| Equipo de cosecha | 0,3 | 42 000 |
| Equipo de traspaso | 0,2 | 28.000 |
| Laboratorios | 0,7 | 98 000 |
| Material de transporte | 0,2 | 28 000 |
| Vehículos | 0,3 | 42 000 |
| Botes | 0,6 | 84 000 |
| Otras instalaciones | 0,5 | 70 000 |
| Estudios | 0,1 | 14 000 |
| Capital de trabajo | 3,5 | 490 000 |
| Total (millones de S/.) | 17,7 | 2 478 000 |
| **TOTAL EN DÖLARES** | 7 375 | 1 032 500 000 |

Como se puede ver el costo de inversión por hectárea es de 17,7 millones de sucres por ha ó 7 375 dólares. La inversión total en el sector es de 2,5 billones de sucres o 1.032 millones de dólares. Para 1997 se debe considerar un incremento entre el 20 % y 25% en los costos de construcción.

La mano de obra directa involucrada en la construcción está constituida por ingenieros, tractoristas, albañiles, mecánicos, jornaleros. Se estima un total de 1,6 hombres por año, de los cuales un 40% es mano de obra calificada y 60% no calificada.

Este valor, es la inversión para todo el período. En el año 1994 se incrementaron alrededor de 6 000 nuevas ha y la inversión en ese año fue solamente de 106 200 000.000 sucres.

## COSTOS DE REINVERSIÓN

En este rubro, no se trata de los costos de mantenimiento normales ni depreciación, sino más bien de costos propios de esta actividad. Es así como la construcción es un proceso permanente, porque cada cierto tiempo debe reconstruirse parte de las obras. Se estima que hay que reconstruir un 60% cada 4 años. Para el presente cálculo, suponemos una reconstrucción del 15% anual. A esto se añade, que los productores, sin incrementar la superficie, intensifican la producción con miras a incrementar la rentabilidad. El sector camaronero ha demostrado que reinvierte por lo menos un 10% cada año.

La reinversión total corresponde a un equivalente de 5.8 veces superior a las nuevas inversiones del país y que no son considerados en los análisis económicos.

En términos de ocupación, significa 6 900 empleos para las inversiones en 1994 y 27 840 para las reinversiones en el mismo año.

## COSTOS DE OPERACIÓN

Para la estimación de los costos se ha utilizado la información de una encuesta realizada a 40 camaroneras de la provincia del Guayas en el año 1985, para la estructuración del índice de costos de la Industria camaronera (IIC) y se ha usado este índice para actualizar los costos a nivel nacional. La camaronera promedio fue de 100 ha (de piscinas) con 25 trabajadores permanentes, una productividad de 650 libras de cola por ha y por cosecha y un promedio de dos cosechas al año.

## ESTIMACIÓN DE LOS COSTOS DE OPERACIÓN ANUAL DE UNA CAMARONERA TIPO DE 100 HA. PARA 1985 Y 1994 (EN SUCRES DE 1985 Y SUCRES DE 1994)

| Rubros | 1985 (100 ha) | 1994 (100 ha) | 1994 (1 ha) |
|---|---|---|---|
| **COSTOS VARIABLES** | **128** | **484,7** | **4,84** |
| Semilla | 21 | 65,9 | 0,66 |
| Balanceado | 37 | 113,2 | 1,13 |
| Urea | 11 | 39,9 | 0,39 |
| Mano de obra | 12 | 65,2 | 0,98 |
| Combustible | 23 | 123,4 | 1,23 |
| Material de empaque y proc. | 21 | 61,7 | 0,62 |
| Servicio de comedor | 3 | 18,4 | 0,18 |
| **COSTOS FIJOS** | **98** | **3 357** | **3,35** |
| Mantenimiento equipos | 26 | 96,8 | 0,97 |
| Servicios generales | 15 | 81,3 | 0,81 |
| Gastos administrativos | 28 | 117,6 | 1,17 |
| Gastos financieros | 5 | 40,0 | 0,40 |
| **TOTAL** | **203** | **820,4** | **8,20** |
| **TOTAL DÓLARES** | **225 500** | **341 883** | **3 481** |

Nota: Para 1997 en el costo de producción anual por hectárea debe considerarse un incremento del 25%

## LOS IMPACTOS INDIRECTOS

### a) De la inversión inicial

Se entiende como encadenamiento, los requerimientos de insumos que se necesitan para incrementar una nueva producción. Así por ejemplo, para la estación de bombeo se necesitan 1 600 unidades de producción (camaroneras) se requieren 9 600 bombas con su motor con un costo promedio actual de 45 millones c/u, sea que se importe o se produzca localmente. Se conoce que las necesidades de este insumo ha hecho que la industria nacional produzca un gran porcentaje de ésta e incluso se exporte por su tecnología y costo. Si la duración promedio es de 5 años cada año se necesitan 1 920 y ocupan 200 personas.

Así podríamos resaltar cada uno de los insumos y estimar sus valores, sin embargo se indicarán otros importantes.

Compuertas. - Generalmente requiere cemento, hierro, piedra, madera y mano de obra.

Muros y piscinas.- Tractores, excavadoras, material pétreo, ingenieros, choferes, mecánicos, jornaleros.

Campamentos.- Insumos parecidos a la construcción de vivienda-

### b) De la operación

Para la operación se requieren los siguientes insumos:

**Semilla:** Se necesitan 120. 000 larvas por ha (en dos cosechas) para satisfacer la demanda de 140 000 ha necesitándose 16 400 000 000 larvas, esta actividad produce ingresos para 90 000 larveros.

Para la producción de larvas en cautiverio se requieren 343 laboratorios, los mismos que tienen una inversión promedio de 130 millones, existiendo grandes diferencias según su forma de producción. Dan ocupación a 2000 personas.

**Balanceado:** Se necesitan por lo menos 1 libra de balanceado por libra de camarón exportado. Si se conoce que se exportaron en 1994, 160 809 070 libras de camarón se requiere la misma cantidad de producto balanceado. Existen 28 fábricas con 2.500 ocupados.

En un tercer nivel de insumos está la harina de pescado y los productos agrícolas como trigo, soya, maíz, etc. Para la producción de harina de pescado se requiere la participación de 30 000 pescadores artesanales y 2 600 industriales.

Luego de cosechar el camarón se requiere el descabezado, lo que ocupa mano obra temporal, posteriormente enfriado, transporte fluvial, transporte terrestre. Esto puede ser realizado por los productores, por las empacadoras o terceros.

Para el proceso final de limpieza, enfriado, empacado existen 78 empacadoras con inversiones en activos fijos de 500 millones de dólares en promedio y que dan ocupación a mas de 12 000 personas (80% son mujeres).

Las empresas exportadoras en un número de 78 aunque su capital fijo puede ser pequeño, requieren como mínimo el 50% del valor exportado, lo que representa un capital de trabajo de por lo menos 270 millones de dólares.

Finalmente, el impacto más importante es la generación de divisas para garantizar las importaciones necesarias, la provisión de un encaje bancario solvente, la estabilidad bancaria y el control de la inflación, ya que después del petróleo y banano es la fuente más importante de divisas.

Resumiendo la ocupación del sector camaronero para 1994 es la siguiente:

### OCUPACIÓN EN EL SECTOR CAMARONERO

| **ACTIVIDAD** | | **NÚMERO DE TRABAJADORES** | |
|---|---|---|---|
| **DIRECTOS** | | | **78 464** |
| Construcción | | 9 600 | |
| Reinversión | | 27 840 | |
| Producción | * | 41 024 | |
| **PRIMER NIVEL** | | | **153 620** |
| Pesca Artesanal | | 50 000 | |
| Pesca Industrial | | 2 600 | |
| Larvas | | 90 000 | |
| Laboratorios de L. | | 1 600 | |
| Balanceados | | 1 800 | |
| Exportadores | | 1 220 | |
| Transportistas | | 6 400 | |
| **TERCER NIVEL** | | | |
| Industrias de insumos , botes redes, cultivos agrícolas, comercios Bancos, etc. | | | |

## LOS RIESGOS NATURALES

En primer lugar están los riesgos naturales. La temperatura ambiental del mar y el fenómeno de El Niño afectan positiva y negativamente la producción camaronera. La abundancia de larvas se ve favorecida por el incremento de la temperatura pero la producción en piscinas se ve afectada por el exceso de lluvias, las cuales afectan infraestructuras y producción. Es así como en 1982-1983 hubo una superabundancia de larvas, mientras que posterior a esos años se registró una marcada escasez.

Luego hay que mencionar la calidad del agua. Las variaciones de salinidad así como las variaciones de oxígeno pueden ser factores de graves repercusiones. La contaminación por agroquímicos (arrastradas por los ríos) envenenan el camarón o deterioran su calidad. Otro factor es la marea roja, fenómeno producido por el "bloom" de ciertas algas que agotan el oxígeno del agua.

La presencia de enfermedades a través de bacterias y virus o por efectos de posibles residuos de contaminantes antropogénicos o naturales que se encuentran en la columna de agua o en los sedimentos es una amenaza latente en el sector, a lo que se debe añadir el peligro de enfermedades a través de materiales e insumos utilizados en las diversas prensas de producción.

En el año 1992 se produjo el síndrome de "la Gaviota" producto del dragado que se efectuó en el canal de navegación de acceso al Puerto Marítimo de Guayaquil.

Síndrome de Taura: Atribuido como producto del uso indiscriminado de fungicidas utilizados para el control de la sigatoka negra en las plantaciones de banano. Sus manifestaciones se evidenciaron a inicios de 1992 cuando los camarones de la zona de Taura comenzaron a experimentar elevada mortalidad, siendo las poblaciones más afectadas aquellas constituidas por camarones entre 0,5 a 3,5g. Este síndrome afectó a más del 30% de la producción camaronera.

Un elevado porcentaje (60%) de la producción depende del suministro de larvas producida por laboratorios, cuya producción está supeditada a externalidades como el comportamiento climático, como a riesgos internos propios de los procesos que podrían en algún momento poner en riesgo la producción en piscinas .

Igual sucede con la producción de alimentos balanceados que depende en gran parte de la proteína animal proporcionada por el sector pesquero pelágico.

## OTROS ASPECTOS.

La producción camaronera ecuatoriana no ha desplazado a ningún sector productivo del país, pues las granjas de producción se asentaron sobre terrenos no aptos para la producción agrícola.

Por otro lado varios países latinoamericanos han diseñado esquemas que permiten mantener o reintegrar la competitividad a sus rubros de exportación, evitando que sus precios externos se vean afectados por impuestos. En el caso ecuatoriano no existen este tipo de incentivos, compitiendo el país en desigualdad de condiciones, sin embargo en el presente año, el gobierno ecuatoriano exoneró a 43 empresas camaroneras del pago del anticipo del 1% sobre los activos totales, impuesto que de acuerdo a las leyes tributarias ecuatorianas debe cancelar el sector empresarial. A pesar del desarrollo y madurez de la actividad camaronera es indispensable la creación de fuentes de financiamiento para el sector productivo y un manejo cambiario realista para el sector exportador.

Existe una agrupación gremial a nivel nacional que es la Cámara Nacional de Acuacultura, creada como Cámara de la Producción mediante Ley No 38 el 28 de Julio de 1993, publicada en el Registro oficial No 251 del 11 de agosto del mismo año, como resultado de la fusión de la Federación de Exportadores de Camarón, La Cámara de Productores de Camarón y de la Asociación de Laboratorios de larvas de Camarón. Esta asociación gremial cuenta al momento con 541 miembros que incluye a productores, exportadores y laboratorios. Existen otras agrupaciones gremiales de carácter local.

# DEVELOPMENT OF SHRIMP CULTURE IN INDONESIA

by

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## 1. INTRODUCTION

Historically, shrimps were produced as by-products of milkfish culture in traditional brackish water ponds. Shrimp became a main product of aquaculture in ponds in the 1980's when the appropriate culture technology, including the technology of mass production of seeds, was available. It was a result of the national programme of shrimp culture development, which was launched to anticipate a reduction of shrimp production following the trawl ban in 1980. Development of shrimp culture in Indonesia was also accelerated by the high value of cultured shrimps and an increase of the demand for cultured shrimps in the world market.

To anticipate the tendency of increasing demand in the world market for shrimps, the Indonesian Government planned to push the development of shrimp culture industry, since shrimp production from wild resources exploitation tended to level off (DGF, 1997). There are, at least, three factors affecting the production of cultured shrimps, namely biological production capacity, environmental carrying capacity and economic conditions. In the past, however, effort has been spent heavily on the maximisation of biological production capacity in order to gain high income, with little attention to the carrying capacity of the environment. Production intensities were increased to levels higher than the environmental carrying capacity. It resulted in crop failures in some coastal areas especially in the northern coast of Java.

Based on the good and bad experiences in shrimp culture, the Government of Indonesia decided to develop a sustainable shrimp culture industry in order to achieve optimum sustainable income, optimum use of natural resources and sustainable environment. The policies of Indonesia to develop this industry include (1) the adjustment of the production intensities of shrimp culture in the Java Island to meet the conditions of sustainable resources use and sustainable production, and (2) the extension of the shrimp culture area into the potential areas outside of Java Island. Total shrimp culture area that will be developed is about 250 thousand hectares (DGF, 1997).

This paper presents the development of the Indonesian shrimp culture sector covering its current state, problems and constraints experienced, institutions and organisations dealing with shrimp culture, and government policies for developing shrimp culture.

## 2. THE CURRENT STATE OF INDONESIAN SHRIMP CULTURE

### 2.1. Pond area, Species and Production

Total area of brackish water ponds in Indonesia increased from 241 thousand hectares in 1986 to 333 thousand hectares in 1995 (Fig. 1). The ponds were managed by 126 thousand units of households.

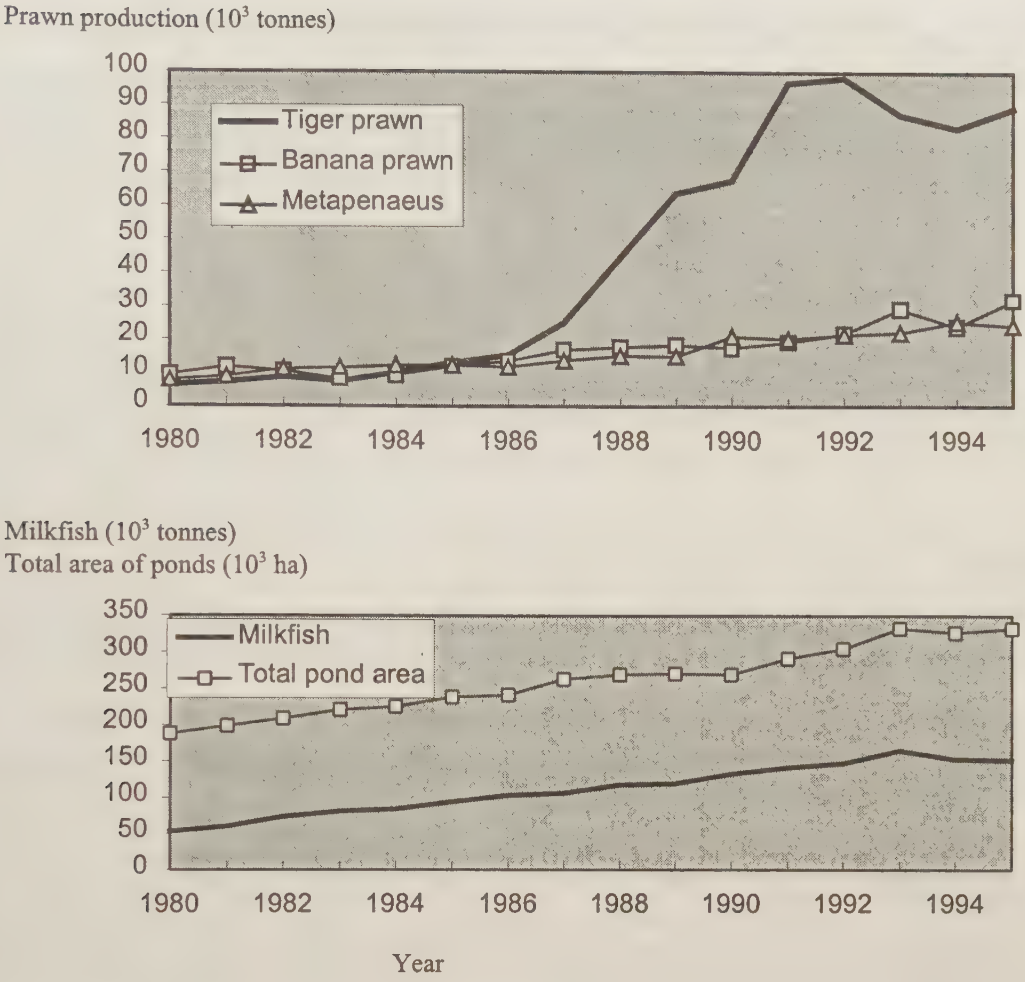

Figure 1. Production of cultured shrimps and cultured milkfish and total pond area, 1980-1995.

There are three species of shrimps harvested from brackish water ponds, namely black tiger prawns (*Penaeus monodon*), banana prawns (*Penaeus merguiensis*), white shrimp (*Penaeus indicus*) and *Metapenaeus* spp. The main cultured species, however, are black tiger prawn (*Penaeus monodon*) and white shrimp (*Penaeus indicus*).

Total shrimp production harvested from brackish water ponds increased from 43 thousand tonnes in 1986 to 144 thousand tonnes in 1992, then declined to 137 thousand tonnes in 1994 (Table 1). The cultured shrimp production in 1995 was about 149 thousand tonnes, which is higher than in 1992.

Table 1. Brackish water pond culture production by species, 1986-1995 ($10^3$ tonnes).

| Species | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 171 | 192 | 233 | 258 | 287 | 323 | 337 | 355 | 346 | 362 |
| | | | | | | | | | | |
| Crustaceans | 43 | 60 | 79 | 100 | 109 | 141 | 144 | 140 | 137 | 149 |
| *Tiger prawns* | 15 | 25 | 44 | 64 | 67 | 97 | 98 | 87 | 83 | 89 |
| *Banana prawns* | 14 | 17 | 18 | 19 | 18 | 19 | 22 | 29 | 24 | 32 |
| *Metapenaeus* | 12 | 14 | 15 | 15 | 21 | 20 | 21 | 22 | 25 | 24 |
| *Others* | 2 | 4 | 2 | 2 | 3 | 5 | 3 | 2 | 5 | 4 |
| | | | | | | | | | | |
| Fishes | 128 | 132 | 154 | 158 | 178 | 182 | 193 | 215 | 209 | 213 |
| *Milkfish* | 104 | 106 | 118 | 119 | 132 | 141 | 147 | 164 | 153 | 151 |
| *Tilapia* | 13 | 12 | 16 | 16 | 20 | 23 | 26 | 22 | 26 | 29 |
| *Mullets* | 4 | 5 | 7 | 7 | 7 | 7 | 9 | 8 | 10 | 11 |
| *Others* | 7 | 9 | 13 | 16 | 19 | 11 | 11 | 21 | 20 | 22 |

Source: DGF, Indonesia.

In 1995, the shrimp culture industry was supported by 233 hatcheries with a total production capacity of 5 billion seeds/year. The industry was also supported by 45 feed factories producing 526 thousand tonnes of feed per year.

The production of cultured tiger prawns during 1986-1995 increased at a rate of 25.1 % per annum. By contrast, the production of the other species of shrimps increased at lower rates (Fig. 1); banana prawns and *Metapenaeus* spp increased at 11.1 and 8.9 % per annum respectively, during 1986-1995.

Production of cultured tiger prawns increased sharply since 1987 (Fig. 1). The production of tiger prawn increased from 15.4 thousand tonnes in 1986 to 89.3 thousand tonnes in 1992. Then, the production declined to 83.2 thousand tonnes in 1994. There were two main problems causing this crop failure, namely environmental quality deterioration and diseases outbreaks in the culture areas along the northern coast of Java. The rate of increase of the tiger prawn production (25.1%/year) was greater than that of the total pond area (3.7%/year). This indicates that the increase in tiger prawn production was not only the result from an extended culture area but also due to the intensification of existing ponds.

## 2.2. Development of Shrimp Culture and the Supply and Price of Cultured Fishes

There were three different ways by which Indonesian farmers developed their shrimp culture, namely intensification of the existing shrimp monoculture ponds, conversion of milkfish culture ponds into shrimp monoculture ponds and extensification of shrimp monoculture and polyculture ponds.

Brackish water ponds also produced fishes. The production of fishes from the ponds also increased in the period 1986 - 1995 (Table 1). Based on the data of brackish water pond culture production in the period of 1986 - 1995, no negative effect of the development of shrimp culture on the supply of cultured fishes was detected (Table 1). Changes in prices of cultured fish, therefore, are not expected to be the result of the development of shrimp culture. No fish price data, however, are available to conduct price analysis.

## 2.3. Export

Shrimp culture has contributed foreign exchange earnings to the Indonesian economy since the majority of cultured prawn production was exported. The total quantity of shrimp export increased from 36.1 thousand tonnes in 1986 to 94.5 thousand tonnes in 1995, worth about US$ 1,037 million (Table 2). The main importing country of Indonesian shrimp production was Japan.

Table 2. Indonesian export of shrimps, 1986 - 1995.

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume ($10^3$ tonnes) | 36.1 | 44.5 | 56.8 | 77.2 | 94.0 | 95.6 | 100.5 | 98.6 | 99.5 | 94.5 |
| Value (US$ $10^6$) | 285 | 353 | 500 | 557 | 690 | 770 | 765 | 877 | 1010 | 1037 |

Source: DGF, Indonesia.

In the early periods of the Indonesian shrimp culture development, shrimp feed had to be imported reducing the foreign exchange earnings. Fortunately, the investment in the shrimp feed industry in Indonesia increased with the development of shrimp culture. The feed mill industry, producing 526 thousand tonnes of feed per year in 1995, could support the shrimp culture industry at the production level of 263 thousand tonnes per year when its feed conversion ratio was 2. Compared with the cultured shrimp production in 1995 of about 145 thousand tonnes, it appears that the feed needed for shrimp culture could be sufficiently supplied by domestic feed factories and foreign exchange earnings saved.

## 2.4. Local Benefits of Shrimp Culture

The development of shrimp culture increased the demand for labour. In 1995, the number of local employees in the shrimp culture industry was estimated at about 287 thousand people. The total estimated wages received by the employees is estimated at about Rp 488 billion per annum.

Table 3. Estimation of the number of employees and their total wages, 1995.

| Production intensity | Total area of shrimp ponds ($10^3$ ha) a) | Estimated number of workers (people/ha) | Total number of workers (people) | Total estimated wages (Rp. $10^6$/year) |
|---|---|---|---|---|
| Intensive | 27.3 | 3 | 81,900 | 209,255 |
| Semi-intensive | 37.1 | 2 | 74,200 | 135,415 |
| Extensive | 262.5 | 0.5 | 131,254 | 143,723 |
| Total | 326.9 | | 287,354 | 488,393 |

Source: a). DGF (1997).

Direct benefit of shrimp culture to farmers is indicated by net returns. Results of socio-economic studies in two districts, Pasuruan and Pati, conducted by the Directorate General of Fisheries shows that the average income of farmers from shrimp culture was greater than that from milkfish culture (DGF, 1994, 1995a). Variable costs, gross returns and gross margin of shrimp culture in a 0.5 ha pond in Karawang (Indonesia) at different stocking densities is presented in Table 4. Figures in Table 4 indicate that intensification of production increased farmers' income. However, intensification of cultured shrimp production is associated with higher risks (Purwanto, 1997).

Sizes of harvested prawns and farm-gate prices fluctuate seasonally (Purwanto, 1997). Consequently, farmers' income also fluctuate in seasonal patterns.

Table 4. Estimated variable costs, production, gross return and gross margin from cultivation of prawns in a 0.5 ha pond in Karawang (Indonesia) at different stocking densities, January 1994.

| | Stocking density (prawns/m$^2$) | | |
|---|---|---|---|
| | 14 | 22 | 30 |
| *Variable cost (Rp. 10$^3$/pond)* | | | |
| Fry | 1190 | 1870 | 2550 |
| Lime | 225 | 225 | 225 |
| Tea-seed | 140 | 140 | 140 |
| Feed | 5927 | 9314 | 12701 |
| Ice | 69 | 111 | 151 |
| Water exchange | 210 | 420 | 690 |
| Paddlewheel operation | 1080 | 1512 | 1728 |
| Pond preparation | 300 | 300 | 300 |
| Cultivation | 300 | 300 | 300 |
| Harvesting | 40 | 60 | 80 |
| Total variable cost | 9481 | 14252 | 18864 |
| *Production, Gross return and gross margin* | | | |
| Production (tonne/pond) | 1.39 | 2.25 | 3.06 |
| Gross return (Rp.10$^6$/pond) | 16.5 | 27.3 | 36.9 |
| Gross margin (Rp. 10$^6$/pond) | 7.0 | 13.1 | 18.0 |

Source: Purwanto (1997).

Development of shrimp culture also resulted in indirect benefits to communities including improvement of roads, irrigation system, availability of electricity and opportunities to carry-out new economic activities related to shrimp culture and entertainment for shrimp culture employees.

### 2.4. Under-Estimation of Production Cost

There were a number of factors that were not considered properly by shrimp farmers and companies in the calculation of production costs. Some factors were under-estimated. These factors included declining tendency of pond productivity, the removal of mangrove, the spread of diseases and the risk associated with the intensities of production.

The productivity of shrimp ponds decreased with time (Purwanto, 1997). However, it can be significantly increased by proper maintenance of soil quality (Purwanto, 1997). The declining rate of pond productivity with time can differ with locations (Purwanto, 1997), which needs different soil treatment to maintain the soil quality. Consequently, the cost for maintaining soil quality should also differ for different locations. However, some farmers and shrimp culture operators spent similar levels of this cost for locations with different soil quality, resulting in a bias.

Mangroves play an important role to support coastal ecosystem. Martosubroto and Naamin (1977) showed a positive correlation between wild shrimp production and the area of mangroves. The removal of mangroves, therefore, can decrease the production of wild shrimp and may affect the ecosystem causing losses to society. The social losses, however, were not included in the calculation of the production cost.

As mentioned in the previous section, intensification of production was associated with higher risk. Consequently, maximising income by intensifying production also increased risk. Purwanto (1997) analysed the environmental risk and showed the trade-off between maximising income and minimising risk in shrimp culture. One example of the risk resulting from the intensification of production was the outbreak and the spread of diseases along the northern coast of Java. This was caused by viral diseases, such as monodon baculovirus and hepatopancreatic parvo-like virus, and bacteria in the hepatopancreas (ADB and DGF, 1994). The losses resulting from the disease problems suffered by Indonesian shrimp culture industry during 1989 - 1992 were about US$ 248 million (ADB and DGF, 1994). However, only few farmers considered the risk in the calculation of production costs and in the planning of their production activities. Purwanto (1997) incorporated the environmental risk in the analysis for production scheduling and allocating limited resources of the studied farms in Karawang (Indonesia). The results suggested that farmers should adopt semi-intensive production system with the stocking densities of 14 and 18 shrimp fry/m$^2$ for most of the ponds scheduled to be operated in order to simultaneously maximise income and minimise risk.

## 3. PROBLEMS AND CONSTRAINTS AND MEASURES TO ADDRESS THEM

There were many factors contributing to the failure of shrimp culture. These factors can be categorised into technical, social and economic problems and constraints.

### 3.1. Technical Problems and Constraints

At the initial stage of shrimp culture development, the main constraints faced by farmers included improper design of ponds for shrimp culture, insufficient supply of water, and inappropriate husbandry practices, such as treatment of pond bottom soil, fry stocking and grow-out technique. Some constraints could be solved by farmers in the 1980's. The main technical constraints in the 1980's consisted of grow-out technique to achieve targeted sizes, maximum quantity of production, and optimum survival and optimum feeding rates. Improvement of pond design and pond management reduced crop failure.

The crop failure in 1994 was caused by two factors, namely disease outbreak and degradation of environmental quality. Other factors causing crop failure in 1994 included the worst dry season in years (DGF, 1995b).

The degradation of environmental quality resulted from off-site and on-site pollution. The off-site pollution resulted from human activities, including industrial, agricultural and domestic activities in the upper reaches of the irrigation system. Meanwhile, the on-site pollution resulted from excessive feed waste and metabolite. The off-site and on-site pollution resulted in the tendency of declining water and soil qualities and increased the probability of disease outbreaks. These factors were worsened by the limited supply of water.

To solve these problem, the Government of Indonesia formed a task force on brackish water pond management and development in 1994. The solution suggested by the task force (DGF, 1995) included:
(1) Utilisation of special ponds for water treatment, including the closed system of water recirculation;
(2) Crop scheduling;
(3) Estimation of environmental carrying capacity;
(4) Commodity diversification;
(5) Coastal area zonation;
(6) Improvement of irrigation canals;
(7) Formulation of the strategy to cope with the disease problems;
(8) Selection of the appropriate technology of sustainable production.

Some studies and experiments have been done to support the effort to solve the crop failure problems. These included (1) A Study on Shrimp Health Management and Disease Control sponsored by Asian Development Bank, (2) Studies and Experiments carried out by Research Institutes of Fisheries under the Agency of Agriculture Research and Development, Brackishwater Aquaculture Development Center under the Directorate General of Fisheries and Universities. Research carried out by some PhD students studying in Indonesia and abroad also contributed several solutions to those problems.

### 3.2. Social and Economic Problems and Constraints

Social and economic problems and constraints faced by cultured shrimp producers in conducting their business included capital and risk, bargaining position of the producers, production management, uncertain changes of shrimp prices, high cost and single main world market.

Shrimp culture is a capital-intensive industry. It is a profitable but risky business. The risk of shrimp culture faced by Indonesian shrimp farmers resulted from various factors including uncertain changes in output prices and environmental conditions. In order to support farmers facing a lack of capital to carry out shrimp culture in 1980's, the Indonesian government set up a special credit programme. Since the risk was associated with the intensification of production, the farmers were adised to adopt semi-intensive production intensity.

Factors which should be taken into account when deriving and evaluating management strategies for cultured shrimp production include biological, environmental and economic elements of a production system. This is a complex decision analysis which should be carried out by management experts with bio-economic educational background. Unfortunately, this was a new field of study and there was only a small number of Indonesians studying this field.

Consequently, production management of shrimp culture in Indonesia was mainly based on bio-physical considerations, which resulted in sub-optimal strategies. An integrated model, incorporating biological, environmental and economic elements, developed by Purwanto (1997) for Indonesian and Australian farms was one example of the decision support components which can be used or modified to derive and evaluate production management strategies.

The bargaining position of shrimp farmers is usually low. The factors resulting in low bargaining position include the perishable nature of shrimp and farm locations in remote areas. Remote farm locations result in high production costs. To solve these problems, the government encouraged shrimp farmers to develop local farmers' associations or cooperatives. A nucleus estate and smallholders system was the other solution to help small scale shrimp culture.

The majority of cultured shrimp production was exported to Japan. Consequently, the industry was strongly affected by Japanese market conditions that caused unstable domestic market conditions. Currently, Indonesian exporters have initiates to penetrate other world markets in order to reduce their dependency on the Japanese market.

## 4. ROLES OF GOVERNMENT INSTITUTIONS AND ORGANISATIONS IN THE DEVELOPMENT OF SHRIMP CULTURE

### 4.1. Central Government

There are three main institutions of the Central Government supporting the development of shrimp culture in Indonesia. These are the Research Institutes of Fisheries, *i.e.* Coastal Aquaculture Research Institute, under the Agency of Agriculture Research and Development, the Directorate General of Fisheries, and Technical Executing Units, *i.e.* Brackish Water Aquaculture Development Center (BADC), under the DGF.

Coastal Aquaculture Research Institute carried out studies and experiments in order to find out new techniques of cultured shrimp production (including seed production). Subsequently, the results of these studies and experiments were assessed or evaluated by BADC to formulate appropriate production techniques. On the other hand, DGF formulated policies and strategies to support shrimp culture development.

### 4.2. Local Government

The cultured shrimp producers can be divided into two categories, namely shrimp farmers and aquaculture companies. Large companies found it relatively easy to hire consultants to help them in their planning and management tasks. By contrast, small-scale companies and individual farmers could not hire private consultant because of their limited means. Therefore, they asked the extension officers in the Fisheries Services to help them to solve the technical problems in the planning and management of their business. The Fisheries Services at provincial and district levels and their executing units supply information and provide advice to shrimp culture producers free of charge. The technical executing units under the Fisheries Services evaluate and assess the appropriate production technologies adapted to the local environment and convey their findings to the shrimp culture operators.

### 4.3. Producers organisations

There are, at least, three shrimp producers' organisations in Indonesia, namely the Association of the Indonesian Coastal Aquaculture Producers (*Himpunan Pengusaha Pertambakan Indonesia*), the Association of Shrimp Fry Producers (*Asosiasi Pengusaha Perbenihan Udang*), and the Association of Intensive Brackish Water Ponds Operators (*Asosiasi Tambak Intensif*). These organisations have played important roles in support of shrimp culture development. The Association of the Indonesian Coastal Aquaculture Producers promoted the exchange of information between its members in order to increase their productivity. However, some information was not disclosed and treated as confidential such as information on production management and new appropriate production techniques. The Association of Shrimp Fry Producers supported shrimp culture development through their activities in producing shrimp seeds while the Association of Intensive Brackish Water Ponds Operators organised the intensive farmers to exchange technical information and to determine proper production intensities which should be adopted. However, these organisations struggled unsuccessfully to solve their marketing problems.

### 4.4. Non-governmental organisations

One mission of the non-government organisations in Indonesia was to campaign for the conservation of coastal ecosystems. This affected cultured shrimp producers indirectly through their awareness on the sustainability of coastal ecosystems and in the planning and management of shrimp culture. Some producers were aware about the impact of high intensity production on the coastal ecosystems, which in turn could affect the sustainability of their business. Therefore, some producers adjusted their production intensities.

## 5. GOVERNMENT POLICY

Based on Indonesian Fisheries Act No 9 of 1985, the Indonesian Government has the authority to regulate the aquaculture industry. The Broad Guidelines of the State Policy (*Garis-garis Besar Haluan Negara*) of 1993 stipulate the authority of the government to develop sustainable aquaculture.

The development of the shrimp culture industry can be traced back to the early 1980's when the government banned the operation of trawlers in Indonesian waters through Presidential Decree No 39 of 1980. The Decree also stated the national programme of shrimp culture development in order to anticipate a reduction of shrimp production from fishing activities.

There are, at least, three strategies that should be adopted in order to attain optimum sustainable benefit from shrimp culture. These strategies include (1) optimizing biological production capacity, (2) optimizing environmental carrying capacity, and (3) minimizing probability of crop failure caused by disease outbreak. Policies needed regarding these strategies include:

a) Restriction of the expansion of brackish water pond areas to meet the carrying capacity of the environment;
b) Assessment of the impacts of shrimp culture on the environment;
c) Conservation of mangrove areas as green-belts of the shrimp culture areas and as components of the coastal ecosystem;
d) Adoption of environmentally-friendly shrimp culture techniques;
e) Coastal area zonation;
f) Optimization of natural resources utilization;
g) Innovation of the technology to utilise water resources efficiently.

To support these policies, the Government of Indonesian has released some regulations. The following decrees are examples of these regulations:

1) The Presidential Decrees dealing with conservation of mangroves especially to form green belts along coastal areas in order to protect the coastal ecosystem. Mangroves also play an important role in purifying coastal sea water from pollutants and in protecting the coastline from erosion.
2) The Ministerial Decree dealing with the assessment of the impacts of shrimp culture on the environment. Based on this decree, the planning of the development of shrimp culture on areas of more than 50 hectares has to be completed with a report containing an analysis of the impacts of this activity on the environment (*Analisis mengenai dampak lingkungan, AMDAL*). This environmental impact assessment has to be carried out by an independent agency.
3) The Ministerial Decree restricting the maximum occupation of the shrimp culture area. Based on past experiences, the optimum area of shrimp culture that can be managed properly by private companies was about 30 hectares on Java Island and about 100 hectares outside Java Island. Therefore, the Government released this decree in order to guarantee the sustainability of the shrimp culture industry. When a private company plans to develop shrimp culture in an area above these optimum sizes, collaboration with small-scale shrimp farms has to be adopted. This collaboration has to be carried out through nucleus estate and smallholders system.

In the next step of the national programme of shrimp culture development, the Government of Indonesia intends to sustain shrimp culture industry through regulating (1) stocking densities to meet environmental carrying capacity, (2) scheduling the stocking activities and cultured species based on the seasonal fluctuation of water quality in order to optimize biological production capacity, and (3) empowering farmers' associations in order to increase awareness of their members in conserving the coastal environment, such as in discharging effluents, maintaining the condition of water canals and optimizing the use of natural resources.

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# CAMARONICULTURA SUSTENTABLE

por la

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## INTRODUCCIÓN

## LA ACUICULTURA EN MÉXICO

Desde el inicio de su promoción gubernamental la acuicultura surge en México como una actividad eminentemente social, dirigida primordialmente a las regiones de extrema pobreza. Aun cuando hoy en día se han dado importantes cambios hacia la tecnificación de la actividad, el sector social sigue siendo el principal beneficiario, ya que la gran mayoría de las granjas y superficie dedicada al cultivo es propiedad de este sector.

En 1996 la producción total nacional ascendió a casi 165 mil toneladas.

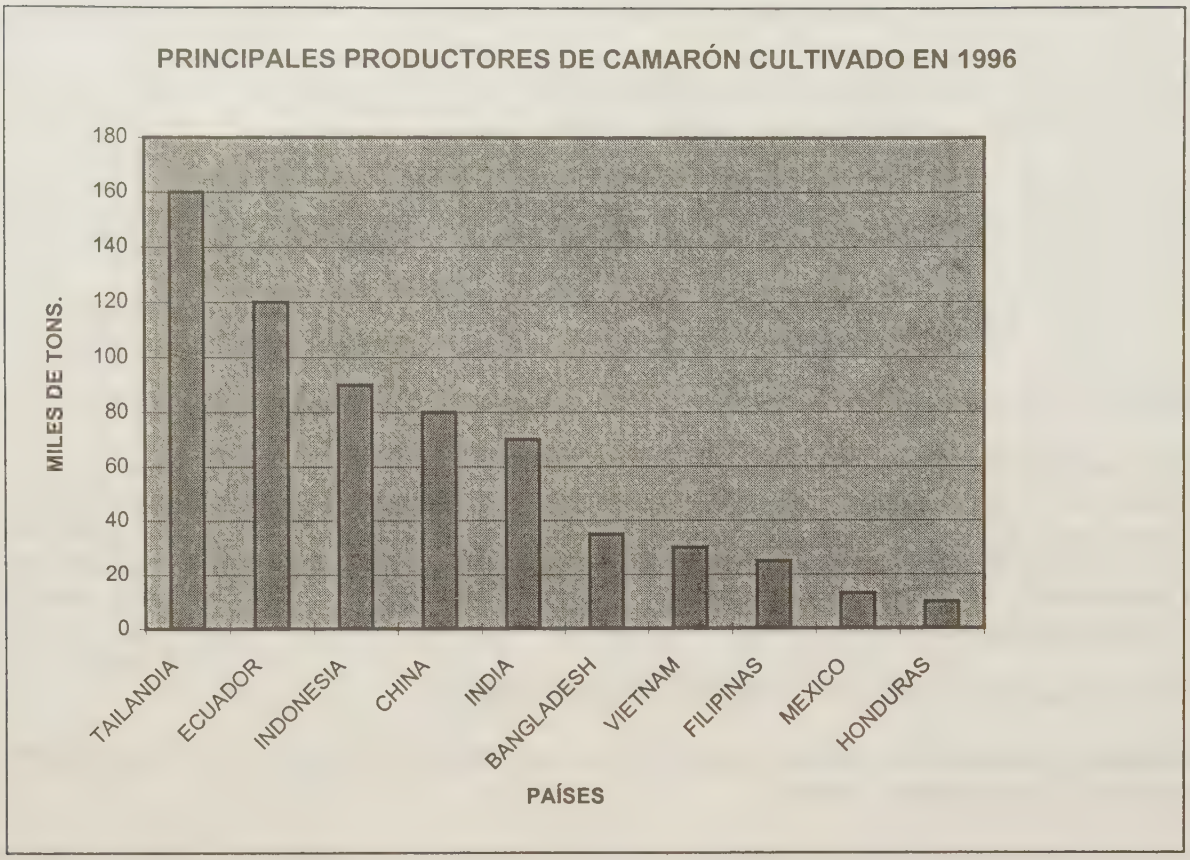
La acuicultura en nuestro país está catalogada bajo tres modalidades de producción: sistemas controlados, pesquerías acuiculturales y acuicultura de fomento.

Los sistemas controlados registran la producción generada en instalaciones construidas para el cultivo de especies con fines comerciales. Los mayores volúmenes de producción los encontramos con el camarón, seguido del ostión y la trucha. En 1996, esta modalidad aporto el 12% del total nacional con casi 20 mil toneladas.

En esta modalidad podemos señalar que la producción de camarón alcanzo casi 14 mil toneladas, es decir, el 8.4% con respecto al total. Cabe mencionar que es sensible la disminución en la producción de esta especie con respecto al año anterior, en el que se obtuvo la producción máxima registrada de poco menos de 16 mil toneladas.

En cuanto al valor estimado de la producción, es notoria la importancia que para nuestro país esta teniendo la actividad. en 1996 el valor de la producción ascendió a 165 millones de dólares a pie de granja, que supero en un 43% los 115.5 millones de dólares correspondientes a 1995. Destacan por su importancia el camarón que aporto 79 millones de dólares; la tilapia con 53.5 millones de dólares; el ostión con 12.1 millones de dólares; la carpa con 11.5 millones de dólares y el resto de las especies indicadas con 9.8 millones de dólares.

Es evidente la importancia que en los últimos años ha tenido la camaronicultura en nuestro país, resultado sin duda de la creciente demanda del producto en los principales mercados mundiales. En la actualidad México ocupa el noveno lugar a nivel mundial y el segundo en América en volumen de producción de camarón cultivado, aportando menos del 2% de la producción mundial y poco mas del 7% de lo producido en el continente americano.


PRINCIPALES PRODUCTORES DE CAMARÓN CULTIVADO EN 1996

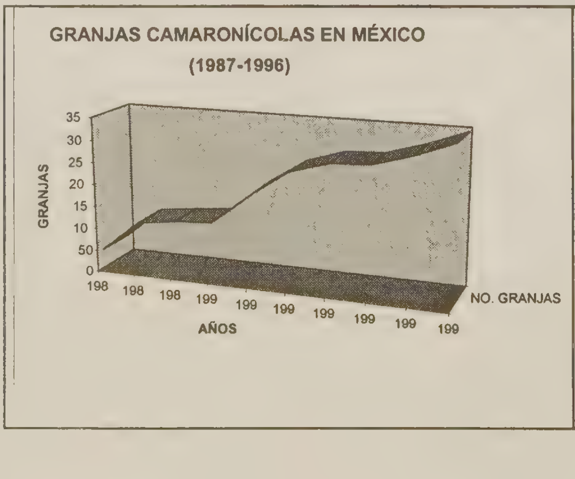
*GRÁFICA*

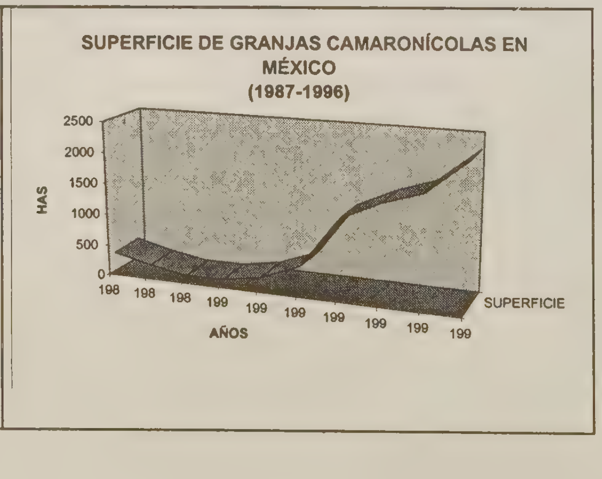
## ANTECEDENTES DEL CULTIVO DE CAMARÓN

## EVOLUCIÓN NACIONAL

El punto de partida para el inicio de la camaronicultura en México se dio a principios de la década de los 70, cuando se empezó a desarrollar la tecnología para su cultivo; lo que sentó las bases para que en 1977 se construyera en el noroeste del país la primera granja de cultivo semiintensivo en una superficie de 7.5 ha.

A partir de entonces se incrementó sustancialmente la construcción de granjas camaronícolas,. En 1987 se tenía un registro de 45 unidades de producción con una superficie abierta al cultivo de 5,338 ha. En 1995 se contaba ya con 319 granjas en 18,151 ha de superficie construida; es decir, el número de granjas se multiplicó casi siete veces y la superficie lo hizo poco más de tres.

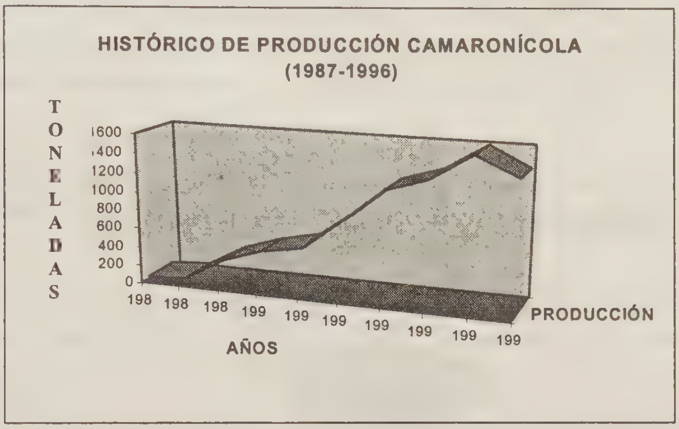

GRANJAS CAMARONÍCOLAS EN MÉXICO
(1987-1996)


SUPERFICIE DE GRANJAS CAMARONÍCOLAS EN MÉXICO
(1987-1996)

## UNIDADES, SUPERFICIE ABIERTA AL CULTIVO Y ESTADÍSTICAS DE PRODUCCIÓN

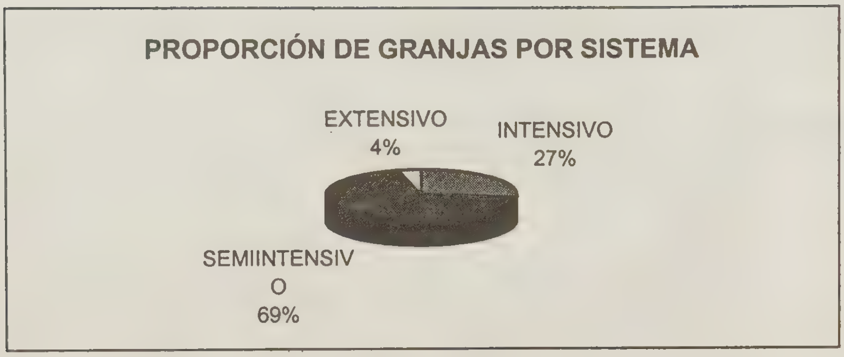
Según los registros de la Dirección General de Acuicultura, en 1996, México contaba con 389 granjas camaronícolas construidas en una superficie total de 22,721 hectáreas. El 99% (376 granjas) se encuentran en el litoral del océano pacífico, al noroeste del país.

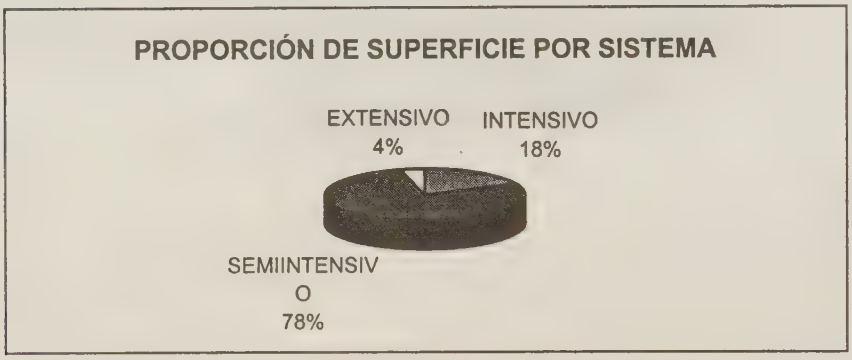
Durante 1996 en México estuvieron en operación 284 granjas en 18,167 hectáreas dedicadas a la producción; con ello se alcanzó una producción de camarón cultivado de 13,315 t de producto entero.



## PRODUCCIÓN, NÚMERO DE GRANJAS Y SUPERFICIE ABIERTA AL CULTIVO DE CAMARÓN EN 1996

| | SI OPERAN | | NO OPERAN | | TOTAL | | |
|---|---|---|---|---|---|---|---|
| ESTADO | No. | Ha | No. | Ha | | | Producción |
| | Granjas | | Granjas | | Granjas | Ha | (Toneladas) |
| Total Nacional | 284 | 18,167.68 | 105 | 4,554.30 | 389 | 22,721.98 | 13,315.00 |
| Litoral Pacífico | 273 | 17,841.48 | 103 | 4,501.30 | 376 | 22,342.78 | 12,783.00 |
| Baja California Sur | 2 | 1.50 | 1 | 1.00 | 3 | 2.50 | 60.00 |
| Colima | 5 | 33.00 | | | 5 | 33.00 | 4.00 |
| Sonora | 20 | 1,965.88 | 9 | 170.86 | 29 | 2,136.74 | 3,505.00 |
| Sinaloa | 162 | 13,955.00 | 75 | 3,854.84 | 237 | 17,809.84 | 7,739.00 |
| Nayarit | 78 | 1,516.80 | 16 | 316.40 | 94 | 1,833.20 | 759.00 |
| Guerrero | 1 | 50.00 | | | 1 | 50.00 | 46.00 |
| Chiapas | 5 | 319.30 | 2 | 158.20 | 7 | 477.50 | 670.00 |
| Litoral Golfo de México | 11 | 326.20 | 2 | 158.20 | 13 | 379.20 | 532.00 |
| Tamaulipas | 9 | 322.50 | | | 9 | 322.50 | 293.00 |
| Veracruz | 1 | 1.70 | | | 1 | 1.70 | 13.00 |
| Tabasco | 1 | 2.00 | | | 1 | 2.00 | 226.00 |
| Campeche | 0 | 0.00 | 2 | 53.00 | 2 | 53.00 | 0.00 |





Adicionalmente con la finalidad de apoyar a los productores y de disminuir el impacto en el medio ambiente, existen construidos en México 33 laboratorios productores de postlarvas; de los cuales durante 1996 operaron 25 con una capacidad de 5,400 millones de organismos. Sin embargo su producción se limitó a los 2,500 millones por diversos problemas tecnológicos, sanitarios y financieros.

## PRINCIPALES AGENTES INVOLUCRADOS

## PROMOCIÓN, REGULACIÓN Y CONTROL

En México los esfuerzos gubernamentales para la promoción del cultivo de camarón se remontan al año 1987 cuando la entonces Secretaría de Pesca elaboró por vez primera un "programa nacional de cultivo de camarón"; ya en este documento se plasma el criterio de desarrollo sustentable del cultivo de camarón con base en políticas y estrategias de respeto y cuidado al medio ambiente con énfasis a las zonas de manglar.

A partir de entonces y hasta 1994, la Secretaría de Pesca a través de su Dirección General de Acuicultura continuó como principal promotor del cultivo de camarón en el país. Durante este período se fueron incorporando a la promoción de la actividad diversos agentes entre los que destacan algunos gobiernos estatales.

Desde la perspectiva del financiamiento, se cuenta con el apoyo del Banco de Desarrollo a través del Banco Comercial y algunos fondos gubernamentales de apoyo a empresas sociales.

Los montos de financiamiento destinados a la acuicultura de camarón por parte del Banco de Desarrollo en los últimos 3 años ascienden a 57 millones de dólares. Cabe señalar que las aportaciones del Banco de Desarrollo se complementan con las aportaciones de las instituciones financieras privadas que actúan como intermediarias.

Por otra parte, se tienen registradas aportaciones de fondos de capital de riesgo por 9.4 millones de dólares.

A partir de 1995, con la creación de la Secretaría de Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP), se integraron en una sola dependencia del gobierno federal las funciones de promoción de la pesca y acuicultura, regulación y normatividad ambiental, aprovechamiento de recursos naturales y protección al medio ambiente, entre otras.

En este contexto la (SEMARNAP) integrada por las Subsecretarias de Recursos Naturales, Pesca y de Planeación, los Institutos Nacionales de Ecología y de la Pesca, la Comisión Nacional del Agua, el Instituto Mexicano de Tecnología del Agua y la Procuraduría Federal de Protección al Ambiente, ha definido con mucha claridad que su misión es la de promover una transición al desarrollo sustentable y frenar los procesos de deterioro ambiental y de los recursos que facilite el desarrollo actual y futuro de los mexicanos; que permita una mejor calidad de vida para todos; que propicie la superación de la pobreza; y, que contribuya a crear una economía que mantenga sus capacidades productivas con base en procesos y tecnologías que no degraden los recursos ni la calidad del ambiente.

Más recientemente han jugado un papel decisivo en el financiamiento de gastos de operación de proyectos camaronícolas, los proveedores de insumos tales como alimento y larvas; así como las principales empresas comercializadoras y exportadoras del producto.

## DESARROLLADORES

En lo que se refiere a los participantes en la producción, cerca del 52% del camarón cultivado en México es producido por el sector privado y el 48% por productores sociales.

El sector privado esta representado en su mayoría por inversionistas con antecedentes en la agricultura o en negocios relacionados con el cultivo de otras especies animales; una menor porción proceden de otras ramas de la industria y sólo unos pocos pertenecen a grandes grupos corporativos.

Las granjas del sector social, son propiedad de grupos dedicados originalmente a la pesca artesanal organizados en cooperativas; o bien de granjeros organizados en "ejidos" que son comunidades campesinas cuyas tierras están sujetas a un régimen de tenencia comunitario. Es importante destacar que un buen número de estas granjas han prosperado en la acuicultura para hacer de ella una actividad prioritaria que, en ocasiones, es la única posibilidad que tienen para mejorar su calidad de vida.

En materia de empleos, la camaronicultura ha generado 7,076 empleos directos en granjas y ha generado beneficios a una población de 34,672 habitantes. Los indicadores en este rubro presentan un promedio de ocupación de 3 personas por 10 hectáreas para una granja semi-intensiva o extensiva; y, de 6 personas/10 ha para una intensiva.

Desde el punto de vista de los salarios, se estima que la camaronicultura genera un promedio de 800 dólares anuales por hectárea dedicada al cultivo. Si esto lo trasladamos a las percepciones de los empleados de una granja según su nivel, obtenemos los siguientes valores:

| NIVEL | SUELDO ANUAL USD | VECES EL INGRESO MEDIO ANUAL DEL PAIS |
|---|---|---|
| Administrador general | 19,200.00 | 8.53 |
| Director de producción | 10,700.00 | 4.75 |
| Personal de vigilancia | 5,540.00 | 2.46 |
| Técnico acuícola | 5,355.00 | 2.38 |
| Contador | 4,260.00 | 1.89 |
| Auxiliares de campo | 2,760.00 | 1..22 |

Como punto de referencia al cuadro anterior, es conveniente mencionar que el nivel de ingreso medio del país durante 1996 fue de 2,249 dólares anuales.

## INVESTIGACIÓN

El recurso humano capacitado es básico para cualquier tipo de desarrollo que se quiera emprender, por eso se ha dado un fuerte impulso a la investigación científica-tecnológica en nuestro país y a la formación de cuadros técnicos especializados, a través de 57 instituciones de investigación y 49 de docencia media-superior, que brindan un importante apoyo a la actividad acuícola, permitiendo disponer de biotecnologías para el cultivo de 26 especies.

Así mismo, la investigación y el desarrollo de tecnologías, permitirán a mediano plazo no sólo la mejora en técnicas de manejo, sino la diversificación productiva con la incorporación de nuevas especies al cultivo.

En particular para el caso del cultivo de camarón, la SEMARNAP ha establecido una serie de convenios con centros de investigación y de docencia para atender las necesidades básicas de la actividad reforzando la capacidad de respuesta tanto de las agencias gubernamentales como de los propios productores, en temas relacionados con impacto ambiental, ordenamiento territorial, sanidad acuícola y capacitación técnica y administrativa, entre otros.

## MARCO REGULATORIO

Con objeto de impulsar la actividad acuícola en un contexto de responsabilidad en el aprovechamiento y conservación de los recursos naturales, a continuación se cita el marco regulatorio vigente que ha permitido realizar controles adecuados para esta actividad, a la vez que promueve su desarrollo sustentable:

### LEYES

- Ley de pesca y su reglamento.
    - Promoción de inversiones.
    - Otorgamiento de concesiones, permisos y autorizaciones en materia pesquera y acuícola.
    - Sanidad acuícola.

- Ley general del equilibrio ecológico y la protección al ambiente y su reglamento.
    - Ordenamiento ecológico del territorio.
    - Evaluaciones de impacto ambiental.
    - Areas naturales protegidas.
    - Manejo especies protegidas.

- Ley forestal y su reglamento.
    - Uso de suelo.
    - Protección a humedales.

- Ley de aguas nacionales y su reglamento.
    - Uso y aprovechamiento del agua.

- Ley general de bienes nacionales
    - Concesiones de zona federal marítimo terrestre y de zona de marismas.

- Ley de inversión extranjera
    - Promoción a las inversiones extranjeras y coinversiones.

### NORMAS

- La norma oficial mexicana 059-ecol-94 que determina las especies y subespecies de flora y fauna silvestre terrestres y acuáticas, en peligro de extinción, amenazadas, raras y las sujetas a protección especial, en la cual se incluye la protección del bosque de manglar.

- Norma oficial mexicana 001-ecol-96 que establece los límites máximos permisibles de contaminantes en las descargas residuales en aguas y bienes nacionales.

- Norma oficial mexicana nom-010-pesc-1994, que establece los requisitos para la importación de organismos acuáticos vivos destinados a la acuicultura y el ornato.

- Norma oficial mexicana nom-011-pesc-1994 para regular la aplicación de cuarentenas en los lotes de organismos acuáticos vivos importados.

- Norma oficial mexicana nom-002-pesc-1993, que regula la captura de postlarvas y reproductores del medio silvestre destinados a la acuicultura.

Actualmente se encuentran en proceso de elaboración otras disposiciones jurídicas que permitirán complementar y adicionar las ya citadas:

## PROYECTOS DE NORMAS

- Norma oficial mexicana 000-SEMARNAP-96 que establece las especificaciones para el manejo y protección de los humedales costeros por el cambio del uso del suelo.

- Norma 021-pesc-94 para los alimentos balanceados, los ingredientes para su elaboración y los alimentos no convencionales para la acuicultura.

- Norma 020-pesc-94 que acredita las técnicas para la identificación de patógenos causales de enfermedades en los organismos acuáticos cultivados, silvestres y de ornato.

- Norma 022-pesc-94 para el control de higiene y la aplicación del sistema de análisis de riesgos y el control de puntos críticos en las granjas acuícolas.

- Norma -000-SEMARNAP-97 para autorizar y registrar los medicamentos y sustancias químicas para el tratamiento de las enfermedades que afectan a los organismos acuáticos cultivados.

- Norma -000-SEMARNAP-97 aspectos de genética acuícola y genes transgénicos.

## OTROS ORDENAMIENTOS Y PROGRAMAS

- Programa nacional para la protección y conservación de las zonas húmedas en México.

- Convenio internacional para la protección de humedales-marismas para aves migratorias.

- Programa nacional del monitoreo de la calidad del agua costera.

- Convención de las Naciones Unidas sobre el Derecho del Mar. Manejo integral de las zonas costeras para la conservación de la biodiversidad.

- Diagnóstico ambiental y desarrollo de una base de datos para la zona costera de la república mexicana.

Es importante destacar que cualquier proyecto acuícola que se instale en México, deberá apegarse estrictamente a las disposiciones aplicables de los ordenamientos que se señalaron anteriormente y que el marco jurídico incluye no solo sanciones administrativas o cancelación de permisos y concesiones a los infractores, sino también la aplicación de sanciones judiciales.

Inmerso en el marco jurídico anterior y específicamente para el subsector acuicultura, el programa de pesca y acuicultura 1995-2000 incluye tres subprogramas que atienden de manera puntual la problemática de la camaronicultura en el país: Ordenamiento del desarrollo acuícola, Modernización del cultivo de camarón y Sanidad acuícola.

## FACTORES PARA LA PRODUCCIÓN SUSTENTABLE

El desarrollo de la camaronicultura en México se ha enfrentado a una serie de limitaciones desde su inicio, algunas de las cuales en su momento han sido solucionadas de tal manera que han permitido un crecimiento pausado pero constante de la actividad.

Sin embargo, prevalecen algunos elementos críticos sobre los que se concentran esfuerzos y de los que depende el mantener o incrementar la tasa de crecimiento de la camaronicultura; la mayor parte de ellos son controlables y están en manos de las instituciones gubernamentales involucradas; otros más deben ser estricta responsabilidad de los productores acuícolas así como de empresarios dedicados a las actividades conexas a la acuicultura; con la atención cuidadosa a estas necesidades por parte de todos los agentes comprometidos con el desarrollo de la camaronicultura, el sector será capaz de prevenir colapsos, o bien mejorar su capacidad de respuesta para reducir sus efectos y consecuencias.

Entre estos elementos identificados como claves para dar un impulso inmediato a la actividad, se encuentran: **el abasto de postlarvas y reproductores a granjas y laboratorios; aspectos sanitarios durante todo el proceso de producción; y, protección al medio ambiente,** entre otros.

### 1. ABASTO DE POSTLARVAS Y REPRODUCTORES:

El principal insumo de las granjas y laboratorios dedicados a la camaronicultura son las postlarvas y los reproductores, por lo que la seguridad en su abasto puede representar la diferencia entre el éxito o el fracaso de la empresa durante el ciclo productivo.

El abasto de la postlarva de camarón del medio natural es esencial para la camaronicultura; sin embargo, la base sobre la cual se decide la cantidad de organismos necesarios para abastecer a las granjas demandantes, tiene como referencia la evaluación del estado de salud que guardan las poblaciones de las especies de camarón requeridas para tal efecto; la protección de las pesquerías establecidas; y, el análisis técnico de las necesidades de los acuicultores.

Se reconoce por parte de todos quienes están involucrados en la actividad, la necesidad de garantizar el abasto de las postlarvas de camarón provenientes de laboratorios certificados sanitariamente, capaces de colocar productos de la mejor calidad a disposición de los demandantes de manera oportuna y en suficiencia.

Lo anterior, nos obliga a dar atención prioritaria a este problema que preocupa tanto al sector gubernamental, como a los directamente ligados a la producción de camarón cultivado. En consecuencia, promover la construcción y operación de laboratorios de producción de postlarvas y reproductores de camarón se debe considerar una actividad de la mayor relevancia, junto con el diseño de un esquema de trabajo que permita hacer más eficiente de manera coordinada **la demanda** de postlarvas y reproductores con **la oferta** del recurso en condiciones naturales.

### 2. PREVENCIÓN Y CONTROL SANITARIO EN INSTALACIONES ACUÍCOLAS:

El cultivo de camarón, a semejanza de otros organismos terrestres o acuáticos, es afectado por enfermedades cuyos agentes causales son de diverso origen. Destacan aquellos de origen viral, contra los que a la fecha no se dispone de tratamientos efectivos para su control ya que en algunos casos las pérdidas de producto pueden llegar a ser del 80 al 100% de la población cultivada.

En continuidad con las actividades desarrolladas desde 1992 en materia de sanidad acuícola, ante este riesgo, el gobierno de México diseñó y puso en operación el subprograma nacional de sanidad acuícola. un componente importante de este, ha sido la instalación y operación de una red de laboratorios inscrita en centros de investigación y universidades con cobertura regional cada uno de ellos, que dan servicios para la prevención, diagnóstico y control de las enfermedades, así como adiestramiento de cuadros técnicos especializados para incrementar la capacidad de respuesta de los productores ante contingencias en materia de enfermedades.

Hasta este momento se tienen claramente identificadas las actividades prioritarias que se deben atender en esta materia; entre ellas destacan:

- Ampliar la cobertura del sistema en red, con la incorporación de nuevos laboratorios para acercar los servicios de diagnóstico y tratamiento en sanidad acuícola a los productores;

- Continuar con la elaboración y actualización de la normatividad necesaria para regular el crecimiento de la acuicultura;
- Regular y controlar importaciones, exportaciones y movilizaciones de organismos acuáticos vivos para evitar transfaunaciones y propagación de agentes patógenos; y,
- Diseñar e instrumentar un sistema de certificación de insumos y productos vivos para la acuicultura.

## 3. PROTECCIÓN AL MEDIO AMBIENTE:

En la transición al desarrollo sustentable de la acuicultura, es necesario promover y regular la instalación de granjas acuícolas en áreas identificadas como propicias para ello. Con base en este planteamiento la SEMARNAP se ha propuesto desempeñar actividades coordinadas con las distintas áreas que la conforman, a efecto de dar cumplimiento a lo dispuesto en el subprograma de ordenamiento del desarrollo acuícola cuyo objetivo general es contar con los elementos que permitan programar y normar el crecimiento de la actividad.

Ante la dinámica de crecimiento de la camaronicultura y la gran diversidad de recursos naturales, ecosistemas y actividades que confluyen en la zonas con potencial camaronícola, el gobierno de México en coordinación con los productores ha dado atención a esta problemática a través de **dos líneas básicas de trabajo**:

### 3.1 ORDENAMIENTO ECOLÓGICO DEL TERRITORIO

El desarrollo e instalación de granjas camaronícolas en México ocurre tiempo antes de la existencia de estudios de ordenamiento territorial que, en la franja costera, normarán el desarrollo de las actividades productivas tomando en consideración a la acuicultura como demandante potencial de espacio y otros recursos naturales indispensables para su desarrollo.

Posteriormente, la ocupación de las áreas con potencial camaronícola en la franja costera fue sujeta a las disposiciones legales que se fueron desarrollando en materia de impacto ambiental. No obstante lo anterior, se considera prioritario el desarrollo de estudios de ordenamiento del uso del suelo y otros recursos naturales que fundamenten la toma de decisiones de las diferentes instancias gubernamentales involucradas con el desarrollo regional productivo y la protección al ambiente.

A partir de 1993 la Dirección General de Acuicultura, de la SEMARNAP, ha elaborado estudios especializados en acuicultura y de ordenamiento ecológico en la zona costera de 7 de los 13 estados con mayor potencial para el cultivo de camarón, que están siendo actualizados y complementados para poder ser empleados como instrumento normativo del desarrollo ordenado de la acuicultura en esas entidades.

Sin embargo, aún cuando se han efectuado esfuerzos y dedicado recursos a la elaboración de estos estudios, se requiere ampliar la cobertura de los ordenamientos territoriales para dar atención a la totalidad de entidades en cuyas costas interactúan diversas actividades productivas.

Es de esta manera como se garantiza la protección y preservación de los ecosistemas costeros, especialmente los sistemas lagunarios y estuarinos poblados de amplias, pero frágiles, extensiones de bosques de manglar y humedales que sirven como refugio a infinidad de especies acuáticas y terrestres que pasan parte o el total de su ciclo de vida en ellos.

### 3.2 DIAGNÓSTICO AMBIENTAL Y REGULARIZACIÓN DE UNIDADES DE PRODUCCIÓN

Una de las acciones mas importantes de la SEMARNAP, ha sido la de regularizar las unidades de producción acuícola existentes en el territorio nacional, especialmente las camaronícolas, dada su extensión y la complejidad ambiental de los espacios que ocupan. En este sentido es conveniente señalar que aún cuando un buen número de granjas fueron concebidas e instaladas en tiempos en que las disposiciones legales y normativas relacionadas con la protección al ambiente, impacto ambiental y manejo de los recursos naturales eran muy generales o estaban poco definidas, éstas, sin excepción alguna, deberán estar sujetas a un procedimiento de regularización de su situación jurídico administrativa precedido por un estudio de diagnóstico ambiental que permita determinar el grado de afectación causado al entorno en que se ubican tomando en consideración los posibles efectos acumulativos del conjunto de granjas que se concentren en cada cuenca.

Derivado de lo anterior, durante 1996 se diseñó y sometió a consideración de los agentes involucrados, el programa nacional de diagnóstico ambiental de ecosistemas costeros y situación jurídica de las unidades de producción camaronícola. En torno al análisis y discusión de dicho documento, se han llevado a cabo reuniones con representantes de diversas áreas internas y desconcentradas de la SEMARNAP. los documentos que han derivado del programa nacional se encuentran en la versión final y durante el mes de noviembre se presentó formalmente el programa ante los productores camaronícolas dando inicio a las actividades que propone.

De las dos líneas de trabajo descritas en esta sección se pueden identificar con precisión, al conjunto de elementos que es indispensable tener en cuenta para alcanzar los criterios de integridad que la actividad requiere: a) ordenamiento ecológico territorial de la franja costera; b) dictámenes de impacto ambiental; c) restauración ambiental de las posibles afectaciones provocadas por la actividad; d) otorgamiento de concesiones de la zona federal; f) control de importaciones, exportaciones y movilizaciones y, e) establecimiento de áreas naturales protegidas.

## CONCLUSIONES

- Coincidimos con quienes afirman que la acuicultura se encuentra en una etapa temprana de desarrollo, lo que nos coloca en una posición privilegiada dado que nos permite aprender de experiencias que se han vivido en otros países, pero no estamos de acuerdo con quienes pretenden trasladar a nuestro país, sin hacer un esfuerzo de análisis, los problemas ecológicos y sociales eventualmente generados en otras partes del mundo.

- En México hay instituciones que se encargan de diseñar e instrumentar mecanismos, estrategias, programas y políticas que, no solo le dan viabilidad al desarrollo de actividades productivas sin deterioro ambiental, sino que permanentemente atienden las demandas y preocupaciones de la ciudadanía.

- Como país, estamos convencidos de la necesidad de impulsar diversas oportunidades productivas, pero no a cualquier costo, porque lejos de traer los beneficios esperados, se podría convertir en un riesgo para las actividades productivas y su permanencia en el tiempo. Reiteramos que el compromiso de la **SEMARNAP** es inducir y acompañar a la sociedad mexicana para que juntos transitemos hacia un desarrollo sustentable.

De lo anterior se desprende la necesidad de enfrentar de manera integral la problemática del sector, mediante las siguientes estrategias:

- Protección del bosque de manglar.

- Uso y aprovechamiento del suelo.

- Uso y aprovechamiento del agua.

- Aprovechamiento responsable de larvas, postlarvas y reproductores de camarones peneidos.

- Prevención, identificación y control de las enfermedades que afectan a las poblaciones cultivadas y eventualmente a las naturales.

- Desarrollo armónico de la acuicultura con el medio ambiente y otras actividades productivas.

Sobre esta base y ante las oportunidades que se abren a la acuicultura por su capacidad para aprovechar racional y responsablemente los recursos naturales, así como generar alimentos, productos de calidad para competir en los mercados mundiales y empleos, se ha desempeñado el trabajo coordinado de productores e instituciones gubernamentales y de investigación, para asegurar las cosechas futuras.

México está dispuesto a continuar trabajando en cooperación con los países y organizaciones interesados en el desarrollo sustentable de la acuicultura.

# PHILIPPINE EXPERIENCE ON SHRIMP CULTURE

by

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## OVERVIEW OF THE INDUSTRY

### A. Status of the Shrimp Industry

Shrimps used to be an incidental species in brackishwater fishponds in the Philippines where milkfish was the major crop before the 1980's.

In 1975, a Philippine firm introduced the then internationally unknown *Penaeus monodon* to the Japanese market by calling it black tiger shrimps. The effort was successful and demand started to rise. This triggered the remarkable growth of the shrimp industry which could be largely attributed to the improved technology in both hatchery and grow-out ponds. As shrimp aquaculture took off the percentage from marine capture fisheries started to decline gradually from 40% in 1982 to 3.23% in 1991.

From the traditional extensive and semi-intensive systems, the adoption of the intensive culture technique from Taiwan (Province of China) using small concrete ponds, high stocking densities, intensive feeding, water aeration, pumping in of fresh and sea water to manage the salinity was promoted. The technology was then modified in each locality to suit the different climatic zones.

Variations in farming systems, however, did not hinder the growth of the industry. From 1,805 mt production in 1982, it increased to 90,426 mt in 1994. (Table 1)

But the growth of the industry was short-lived. Starting in 1992 the industry started to be plagued with problems of environmental pollution and degradation resulting in poor growth and mass mortality due to diseases. Although the impact on total production was felt only in 1995, for the export industry it started in 1991 when traces of antibiotics was discovered in one batch of Philippine shrimps by Japanese authorities.
The presence of antibiotics compelled the Japanese authorities to subject Philippine shrimps to a total instead of random check. This situation ended in 1993 when the Philippine government interceded with the Japanese government. By that time however, Philippine exporters already lost a substantial portion of the Japanese market which absorbs 75% of the shrimp export .

When the price of shrimps in the international market picked up in 1994 many of the intensive shrimp farms have ceased operation. It is estimated that out of the 47,776 ha of shrimp farms in 1991 only about 20,000 ha is now in operation. Only those areas practicing extensive and semi-intensive farming continue to operate.

TABLE 1. Philippine shrimp production from aquaculture and export volume, 1987-1996.

| **YEAR** | **PRODUCTION (mt)** | **EXPORT (mt)** | **VALUE OF EXPORT (000 US$)** |
|---|---|---|---|
| 1987 | 32,380 | 15,390 | 155,669 |
| 1988 | 41,548 | 24,288 | 251,752 |
| 1989 | 43,539 | 26,767 | 223,600 |
| 1990 | 47,591 | 25,205 | 222,578 |
| 1991 | 45,740 | 30,461 | 272,965 |
| 1992 | 75,996 | 23,623 | 211,448 |
| 1993 | 86,096 | 22,734 | 224,700 |
| 1994 | 90,426 | 22,418 | 246,317 |
| 1995 | 88,815 | 18,257 | 218,652 |
| 1996 | 76,220 | 13,514 | 153,354 |

Source: *Bureau of Agricultural Statistics*

1. Areas devoted to shrimp farming

Luzon has the highest hectarage of shrimp farms in the country with 20,940 ha (44%), Visayas second with 14,314 ha (30%) and Mindanao, third with 12,519 ha (26%) in 1991. However between 1992 and 1993, just one province alone in the Visayas, Negros Occidental, produced more shrimps than all the other provinces combined (Table 2). This was because Negros Occidental shrimp growers invested heavily on intensive culture facilities.

2. Shrimp farming systems

Shrimp farming in brackishwater ponds utilized a variety of systems as influenced by the climatic zone, capital availability, tidal variations, source of water supply, marketing of products and availability and cost of farm inputs. These resulted to difference in farming systems adapted such as:

TABLE 2. Comparative production of shrimps between Negros Occidental with other provinces

|  | **NEGROS OCCIDENTAL** | **OTHER PROVINCES** |
|---|---|---|
| 1992 | 34.9 | 24.7 |
| 1993 | 48.2 | 36.8 |
| 1994 | 34.5 | 55.8 |
| 1995 | 29.8 | 59.0 |
| 1996 | 17.8 | 58.3 |

Source: *Bureau of Agricultural Statistics*

a. Traditional farming system

It is characterized by irregular shapes and large size ponds ranging from 2 to 35 ha, shallow water at 40 to 80 cm, and low stocking density of 3,000-9,000 fry/ha. Water management is dependent totally on tidal fluctuations. It depends argely on natural food Polyculture with milkfish is practiced and larger shrimps (40-70 g) are produced. Production range from 100 to 200 kg/ha/yr. Culture period is 100-120 days with 20-50% survival rate.

b. Extensive farming system

Pond sizes range from 1 to 5 ha, water depth at 80 cm, a single gate is used for both water supply and drainage; stocking density ranges from 1 to 5 fry/m$^2$, with 2 croppings/yr. Supplemental feeding consist of commercial pellet, trash fish, snails or mussel meat, singly or in combination with each other whichever is available. Water management is through tidal fluctuations with occasional pumping. Culture period is 120-200 days and survival rate is 60-80%. Average production per hectare per crop is 200-900 kg per year.

### c. Semi-intensive / Intensive farming systems

These culture systems are characterized by: small pond sizes, ranging from 0.25-0.80 ha for intensive and 0.3-1.5 ha for semi-intensive. Properly levelled pond bottom, dikes made of earthen materials or sides are lined with plastic sheets, concrete or boulders. Water depth is 1.0 m or higher, with separate inlet and outlet water gates or small inlets from open canals. Some ponds are designed with a centrally located drain pipe for waste and water management combined with a side drain gate for harvesting. Some, especially those dependent on tidal supply of water are designed with a reservoir. Open canal or flume is used to transport large volumes of water into the pond system. Seawater and freshwater from the source (river, creek, bay, etc.) are usually filtered or screened to prevent entry of predators and competitors. Modified sand filters and very fine stainless steel mesh and plastic screens are widely used. Low-head, high-volume axial pumps, submersible or centrifugal pumps are used for pumping seawater and while deepwell for freshwater is a must.

Hatchery-produced PLs are used for stocking at densities of 5 to 20 /m$^2$ in semi-intensive and more than 20 fry/m$^2$ for intensive culture systems. Culture period is 120-180 days for semi-intensive and 140-155 days for intensive. Number of croppings range from one to two per year. Commercially formulated pelletized feeds are used. Survival rate range from 75-90% in semi-intensive farms and 80-90% in intensive ponds. Production range from 1,840 to 6,800 kg/ha/crop with average body weight (ABW) of 31-35 gm in semi-intensive and more than 3,500/ha/crop in intensive with an ABW of 25-30 gm. Aeration with the use of paddle wheels, diffusers or air injectors are necessary due to the large biomass and high biological oxygen demand (BOD).

## B. Macro Economic Benefits

### 1. Foreign Exchange Earnings

Shrimp became one of the top exported products of the Philippines from 1987 to 1992. As shown in Table 2, from an export of 15,390 metric tons in 1987 it rose to 30,461 metric tons in 1991 valued at US$272,965,000 which was considered the peak year of the industry

From 1989 to 1991, shrimps in fresh, chilled and frozen farms constituted the second fishery exports of the Philippines in terms of volume with a value of US$223,600,000 in 1989 and US$272,965,000 in 1991, while in 1992 to 1996 it was the third among the fishery exports in terms of volume although in terms of value, shrimps was still the highest among the products in the same years. The largest market of Philippine shrimps is Japan which absorbed 75% of the export. The rest were exported to U.S. and some European countries.

In 1989 and 1990, the value of shrimps from aquaculture constituted 11.2% and 8.4% respectively of the total value of fish production. Also, in the same years, shrimps contributed 2.7% of the value of the total exports of the country. The share in value of shrimp among agricultural exports in 1989 and 1990 was 13.2%.

## C. Local Benefits of Shrimp Culture

### 1. Direct Employment

The shrimp industry consist of four major components: hatcheries, grow-out farms, feed mills and processing. In a study conducted by the Auburn University Team in 1993, it was estimated that the number of people employed in the four different components totalled 65,580.

The grow-out operation contributes the largest share of the employment. The hatchery industry was second, followed by processing/exporting industry, and last is the feed milling industry. The total employment benefit from the shrimp industry in 1993 when it was at its peak was valued at P629,000,000.

Rural dwellers, both skilled and unskilled, primarily benefited in the employment since shrimp ponds, hatcheries, feed mills and processing plants are all located in the country side. Employment in ancillary businesses was also great.

### 2. Growth of Ancillary Business

With the growth of the shrimp industry, ancillary businesses such as the fishing net industry, prawn trading, dealerships of feeds, brood stock/spawner collection, fry gathering, machinery fabricators and construction materials dealers also grew correspondingly.

### 3. Enhanced Country-side Development

#### a. Business Opportunities

The hatchery business provided a good investment opportunity for small investors living in the country-side. It also attracted investors from other areas, hence, value of lands located in suitable areas along the shorelines which used to be unproductive, went up.

#### b. Electrification of rural areas

The need for electricity to operate the machineries for hatchery and farm operation hastened the electrification of the country side.

#### c. Construction and Improvement of Roads

Since shrimp projects are usually located in areas far from national and provincial roads, roads and bridges were built in the said areas to provide acces and facilitate the transport of inputs and the marketing of harvests.

## D. Economics of Shrimp Farming

### 1. Operating cost

The operating costs of shrimp farming consist of fry, feeds, pond preparation, power, fuel/oil/lube, salaries and allowances, repair and maintenance. The amount varies by culture system and by region. Based on the survey by the Auburn University Team in 1993, the cost of fry and feeds are the major variables in the industry. The average fry cost share per hectare for extensive was 24% (P6,610), 13% (P47,240) for semi-intensive and 9% (P51,610) for intensive. (Table 3 & Table 4)

Feeds dominate the operating costs of semi-intensive and intensive systems. The average feed costs in all regions in the extensive, semi-intensive and intensive systems were: 26% (P7,400/ha); 56% (P208,830/ha) and 66% (P398,090/ha) respectively.

TABLE 3. Production Parameters and Share of Variable Cost by System for Philippine Shrimp Farming, 1992

| PRODUCTION PARAMETERS | EXTENSIVE | SEMI-INTENSIVE | INTENSIVE |
|---|---|---|---|
| Area (ha) | 20.20 | 12.52 | 36.87 |
| Stocking density (sq.m.) | 2.24 | 12 | 23.38 |
| Days of culture (DOC) | 151.40 | 138 | 156.50 |
| Survival rate (%) | 57 | 68 | 77 |
| ABW (gms) | 25.76 | 30 | 31.44 |
| FCR | 0.70 | 1.79 | 2.04 |
| Yield/hectare (kg/ha) | 303 | 2,772 | 5,325 |
| % OF TOTAL VARIABLE COST | | | |
| Fry | 24 | 13 | 9 |
| Feeds | 26 | 56 | 66 |
| Pond Preparation | 3 | 5 | 2 |
| Power | 0 | 11 | 10 |
| Fuel/oil/lube | 1 | 1 | 1 |
| Salaries & allowances | 14 | 8 | 7 |
| Repairs & maint. | 13 | 3 | 3 |
| Others | 19 | 2 | 3 |

Power costs on the average accounted to 11% (P48,480) of the operating cost per hectare for semi-intensive and 10% (P58,400) per hectare for intensive operations.

Salaries and allowances tended to be higher in less intensive system.

2. Return on investment

The investment cost, consisting of land, development, equipment, and building as well as the return on investment varies on a per hectare basis from region to region and by production system. Generally, in extensive farms, earthen ponds are used, while dikes for semi-intensive ponds are either earthen, riprap or concrete. Dikes for intensive ponds are riprap or concrete. The cost of land is a small percentage of the total investment for semi-intensive and intensive systems, but can be important for extensive ponds. Table 5 shows the comparative investment costs by culture system.

TABLE 4. Production Parameters and Cost and Returns Per Hectare for Philippine Shrimp Farming, 1992

| PRODUCTION PARAMETERS | EXTENSIVE | SEMI-INTENSIVE | INTENSIVE |
|---|---|---|---|
| Area (ha) | 20.20 | 12.52 | 36.87 |
| Stocking density (sq.m.) | 2.24 | 12 | 23.38 |
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| Survival rate (%) | 57 | 68 | 77 |
| ABW (gms) | 25.76 | 30 | 31.44 |
| FCR | 0.70 | 1.79 | 2.04 |
| Yield/hectare (kg/ha) | 303 | 2,772 | 5,325 |
| Receipts (P000/ha) | 58.96 | 418.43 | 773.86 |
| OPERATING COST AND RETURNS/HA (P000/ha) | | | |
| Fry | 6.61 | 47.60 | 51.61 |
| Feeds | 7.40 | 208.83 | 398.09 |
| Pond Preparation | 0.98 | 19.65 | 10.89 |
| Power | 0.01 | 42.31 | 58.40 |
| Fuel/oil/lube | 0.27 | 3.91 | 7.78 |
| Salaries & allowances | 3.96 | 30..51 | 39.50 |
| Repairs & maint. | 3.63 | 11.37 | 17.85 |
| Others | 5.20 | 7.04 | 15.83 |
| Subtotal/ha | 28.06 | 371.21 | 599.96 |
| Interest on variable cost/ha/cycle | 1.40 | 16.79 | 30.87 |
| Total variable cost/ha/cycle | 29.45 | 388.00 | 630.82 |
| Total variable cost/kg/cycle | 97.25 | 139.99 | 118.47 |
| Income above variable cost/ha/cycle | 29.51 | 30.43 | 143.04 |
| Subtotal/ha/yr | 38.29 | 535.88 | 871.26 |
| Interest on variable cost/ha/yr | 1.91 | 24.23 | 44.83 |
| Total variable cost/ha/yr | 40.20 | 560.11 | 916.09 |
| Total vaiable. cost/kg/yr | 88.48 | 202.08 | 114.69 |
| Income above variable cost/ha/yr | 48.24 | 67.53 | 244.71 |

Initial investments tend to go higher with additional improvement in the area. Extensive earthen pond costs P150,000; while semi-intensive and intensive farms cost P450,000 and P700,000 for riprap and concrete respectively.

To determine the return on investment by culture system, a sensitivity and break-even analysis is shown in Table 6.

TABLE 5. Investment costs per hectare (PHP"000) for various shrimp farm systems (1992) in thousand pesos (US$1.00 = PHP25.00)

| ITEMS | EXTENSIVE | SEMI-INTENSIVE | INTENSIVE |
|---|---|---|---|
| 1. Construction Cost | | | |
| earthen | | | |
| riprap | 150 | 150 | 150 |
| concrete | | 450 | 450 |
| | | 700 | 700 |
| 2. Equipment | 36.5 | 132 | 166.5 |
| 3. Building | 14 | 44 | 44 |
| TOTAL INVESTMENT | | | |
| earthen | | | |
| riprap | 200.5 | 326 | 360.5 |
| concrete | | 626 | 660.5 |
| | | 876 | 910.5 |

TABLE 6. inimum return on investment on a per hectare basis at minimum mortality to attain minimal profit based on a sensitivity analysis in 1992.

| CULTURE SYSTEM | MINIMUM MORTALITY RATE REQUIRED | ESTIMATED NET RETURN (P000/ha) | TOTAL INVESTMENT/ HA (P000/ha) | MINIMUM RETURN OF INVESTMENT (%) |
|---|---|---|---|---|
| Extensive | | | | |
| Earthen pond | ≤30% | 3,280 | 200 | 1.64% |
| Semi-intensive | | | | |
| Earthen | ≤35% | 23,670 | 326 | 7.26% |
| Riprap | ≤25% | 35,190 | 626 | 5.62% |
| Concrete | ≤20% | 24,270 | 876 | 2.77% |
| Intensive | | | | |
| Riprap | ≤35% | 57,910 | 660.5 | 8.77% |
| Concrete | ≤35% | 16,710 | 910.5 | 1.83% |

Source: *Philippine Prawn Policy Study by Auburn University, 1993*

A sensitivity analysis indicated that in order to obtain a minimum return of investment the mortality rates should be no more than 30% for extensive, 20-35% in semi-intensive depending on the construction type, and 35% in intensive culture systems.

Using the earthen and riprap ponds for semi-intensive culture gave a bigger return of investment over the concrete ponds. This shows that in semi-intensive culture, it is not necessary to use concrete dikes for the grow-out ponds.

The extensive culture gave a low return of investment which was only 1.64%. Intensive culture in riprap ponds gave a higher ROI of 8.77% Furthermore, the variability in the operating costs played important roles in the production.

Intensive culture is extremely sensitive to the cost of feeds, compared to extensive culture. The semi-intensive culture using earthen ponds have a large margin of safety for feed cost. Break-even price to cover all costs for intensive and semi-intensive systems is much higher than the extensive system.

### E. Impact of Shrimp Culture on Other Species

From 1980 to 1988 when the craze to produce shrimps for the export market was at its height, fishponds ordinarily used to produce milkfish were converted into shrimp ponds by introducing some modifications. Approximately 20% of the 253,854 ha developed brackishwater fishponds were used. In addition, sugarlands and agricultural lands were also developed into intensive shrimp ponds. Milkfish production from ponds declined and prices went up to PHP60 kg.

In 1992, when the shrimp industry was plagued with problems of diseases and poor growth due to environmental pollution and degradation, most of the shrimp farmers reverted to milkfish culture. As a result, the price of milkfish decreased. To date, the cost of milkfish in the local market is quite low ranging from P35.00 to P45.00 per kilo (farmgate price) while the price of shrimps became prohibitive ranging from P200.00 to P300.00 per kilo, depending on the size.

## INSTITUTIONAL SUPPORT TO THE INDUSTRY

### 1. Government

To support the shrimp industry, the government provided infrastructure facilities such as ice plants and cold storage; roads, ports, airports. Credits and loans are made available by government banks to all sectors of the industry (grow-out ponds, hatcheries, feed millers and processors). Technical and extension services are provided. Technology is generated through research and development by funding universities and research agencies. Shrimp producers are provided incentives in the form of tax exemptions and tax credits. Recently, tariff fo imported feed ingredients was lowered from 10% to only 3%.

Regional diagnostic laboratories were established to cater to the needs of the industry. In addition, cooperative laboratories were given financial support as well as badly needed equipment and training of laboratory staff.

Recently, in view of the problems besetting the industry particularly in areas practicing intensive culture, the Department of Agriculture formed a multi-agency task force called Oplan Sagip Sugpo which literally means Save the Shrimp. The objective is to rehabilitate the shrimp industry by assessing existing shrimp ponds, selecting culture systems known to be environmentally friendly in approach for piloting in areas where the industry has virtually collapsed.

### 2. Private Sector

The private sector has contributed significantly to the development of the shrimp industry. Some shrimp pond operators formed into associations and cooperatives which put up facilities like laboratories for diagnostics and water quality monitoring. Large corporations in the industry undertake their own research and development activities and provide technical assistance. Private banks also provide credit support.

## PROBLEMS AND CONSTRAINTS

Major problems confronting the shrimp industry can be classified into the following :

### 1. Technical

#### a. Poor site selection and construction

Most farms used for shrimp culture were originally developed as traditional ponds for milkfish. These are constructed along narrow rivers utilizing the river as the water supply and drainage area. Effluents drained by one farm is inevitably pumped in by another. Other ponds were built along tidal rivers too far from the sea such that during rainy season, brackishwater barely reaches the area. Most ponds were constructed in estuaries because it was the usual practice to use brackishwater for growing shrimps.

The use of relatively shallow fishponds with low water exchange rates (10-15% per day) that are easily affected by sudden change of temperature during hot days and colder nights is common.

### b. Environmental pollution and deterioration

Aquatic environments are generally used as dumping areas for industrial and agricultural wastes, including effluents from shrimp ponds which are loaded with high nutrients and organic matter from feeds and fertilizers. This promotes bloom of plankton and anaerobic sediment conditions and alter the water quality into one that favors proliferation of pathogenic bacteria and other harmful organisms.

### c. Diseases

Since 1992, poor pond water and soil quality due to accumulation of uneaten feeds and shrimp feces has resulted in slow growth, poor survival and oftentimes total mortality. Diseases became more prevalent. These included the Monodon baculovirus (MBV) and luminous bacteria disease. The indiscriminate use of antibiotics and other chemical therapeutics in the past has resulted in a resistant and virulent strain of the bacteria *Vibrio harveyi*, the major cause of the luminous bacteria disease.

## 2. Social

### a. Conflict over the use of resources

Conflicts between stakeholders over the use of river channels for subsistence fishing, prawn farms. Conversion of mangrove areas into prawn ponds had deprived other users of the resource. Dumping of wastes into the aquatic environment alters the water quality affecting the fish stock thus depriving the coastal inhabitants of the resource.

### b. Privatization of resources and marginalization of coastal communities

The conversion of mangrove areas into fish ponds and shrimp ponds transforms multiple-user resources to a single-purpose resource. This situation leads to marginalization of coastal communities since the stable and varied source of income which is the mangrove are replaced by seasonal and less dependable employment in the fishponds.

### c. Water and soil salinization and land subsidence

The impact of excessive extraction of ground water results in salinization of freshwater aquifers and reduction in the supply of potable, industrial and agricultural water. There were previous reports that agricultural plants near shrimp ponds died in Visayas and Mindanao, caused by soil salinization and lack of freshwater. Likewise, land subsidence have been also reported in Cebu and Negros provinces.

## 3. Economic

### a. High development cost

The use of small ponds with rip-rapped dikes and waterways requires a big capital investment. In 1980's a one-hectare pond required about US$40,000 - US$50,000 for development including elevated concrete water flumes, deep wells, elaborated lightings, electrical facilities and farmhouse. This makes recovery of initial investment difficult.

### High cost of production

Feed is the major input in shrimp production varying from 55-70% in semi-intensive and intensive systems. Compared with other shrimp producing countries like Thailand, Indonesia, China, Vietnam and India, the price paid by Philippine shrimp growers is significantly higher.

Although there are fry quality criteria established by some shrimp hatcheries, performance of fry in pond were not as good as expected. Operators usually attained low survival rate, hence, high stocking density is done to offset the mortality.

The high cost of money from commercial banks with interest rates from 24% to 30% made shrimp farming less lucrative especially when export quantity and prices decreased. The stringent collateral requirements of banks for loans discouraged most fishpond operators especially those who had difficulty in liquidating previous loans to borrow and invest in shrimp ponds.

In intensive ponds where continuous operation of aerators/paddle wheels and pumping in of water are required, energy consumption is high, thus adding to the production cost.

The high transportation cost in the product transport, both local and international, makes the product non-competitive in the foreign market.

4. Institutional

The government incentive are in terms of tax credit on imported feeds, ingredients and chemicals needed by the industry. But very few shrimp farmers availed of such incentives due to the time and paperwork involved in processing their claims.

## LEGAL AND ADMINISTRATIVE ASPECTS IN SHRIMP CULTURE

Policy: Sustainable development within ecological limits of the environment

Means to attain the policy

a.1 Promotion of the semi-intensive culture of shrimps in ponds which is an environment-friendly technology.

a.2 Integrated coastal area management scheme

Coastal communities through trainings are encouraged to actively participate in coastal resource management such as protection of the fishery resource, mangrove rehabilitation, etc.

In the absence of regulations by the government on the protection of the environment against pollution from shrimp farming operation, fishpond operators just dump their waste water into the nearby aquatic areas. The effluents caused pollution of the receiving environment. Hence, formulation of regulations based on a clear understanding of the interaction between shrimp farming and the environment is wanting. Likewise, regulations protecting shrimp farming from other harmful effluents should be promulgated.

2. Laws and regulations pertaining to shrimp culture

| YEAR | LEGISLATION | SCOPE |
|---|---|---|
| 1975 | PD 1076 | Water code of the Philippines providing for the use of water for fisheries and propagation/culture of fisheries as a commercial enterprise |
| 1976 | PD 600 | Marine Pollution Decree<br>Pollution of sea by dumping of wastes and other matters declared illegal |
| 1977 | PD 1160 | Vesting the authority to Barangay Captains to enforce pollution and environmental control laws and for other purposes |
| 1980 | PD 1144 | Vesting to Fertilizers and Pests Authority to regulate or ban the use of pesticides |
| 1982 | FAO 141 | Banning the exportation of live gravid shrimps of genus Penaeus |
| 1983 | FAO 143 | Banning the exportation of live prawn (sugpo) of the species P. monodon |
| 1987 | DENR AO | Ban on the conversion of mangroves into fishponds |
| 1987 | DENR AO 76 | Establishment of buffer zones (50m ) fronting seas, oceans, oceans, and 20m along riverbanks, fishpond owners required to plant mangrove strips |
| 1991 | RA 7160 | Local Government Code |

| YEAR | LEGISLATION | SCOPE |
|---|---|---|
| 1991 | BFAR AO 125-1 | Increase in fishpond lease from P50 to P1,000/ha/yr effective 1992 |
| 1991 | BFAR AO 125-2 | Full implementation of AO 125-1 delayed to 1994 |
| 1992 | DA AO Circ. 4 | Regulating the use of drugs for animals and ban the use of organotins |
| 1994 | FAO | Allowing exportation of live pond-reared shrimps not more than 50 gms in weight |
| 1995 | RA | Exemption of aquaculture areas from the Comprehensive Agrarian Law |
| 1996 | Tariff Code | Lowering the tax and tariff duties on imported feed ingredients from 10% to 3% |

| | | | |
|---|---|---|---|
| **RA** | *Republic Act* | **DA** | *Department of Agriculture* |
| **PD** | *Presidential Decree* | **DENR** | *Department of Environment and Natural Resources* |
| **AO** | *Administrative Order* | **BFAR** | *Bureau of Fisheries and Aquatic Resources* |
| **FAO** | *Fisheries Administrative Order* | **BOI** | *Board of Investments* |
| **Circ.** | *Circular* | | |

## GOVERNMENT INSTITUTIONS CONCERNED WITH SHRIMP CULTURE

| INSTITUTIONS | FUNCTIONS |
|---|---|
| **Department of Agriculture (DA)** | |
| Bureau of Fisheries and Aquatic Resources (BFAR) | Planning, licensing, monitoring, operation and evaluation<br>Research management and field monitoring |
| Regional Field Offices | -do- |
| Bureau of Animal Industry (BAI) | Control and regulation on the administration of drugs and antibiotics to animals |
| Bureau of Agricultural Research (BAR) | Coordination, research |
| Bureau of Agricultural Statistics (BAS) | Production statistics |
| Agricultural Training Institute (ATI) | Training and technology transfer |
| Fertilizer and Pesticides Authority (FPA) | Licensing, control and regulation of pesticides |
| Philippine Fisheries Development Authority (PFDA) | Establish cold storage facilities, ports, harbors and marketing facilities |
| **Department of Environment and Natural Resources (DENR)** | |
| Forest Management Bureau (FMB) | Issues permits for utilization of mangrove for fishponds |
| Land Management Bureau (LMB) | Land classification |
| Environmental Management Bureau (EMB) | Environmental policy, planning and management |
| **Department of Health (DOH)** | Monitoring and health hazard regulation |

| INSTITUTIONS | FUNCTIONS |
|---|---|
| **National Mapping and Resource Information Authority (NAMRIA)** | Resource mapping, land use and water management |
| **National Water Bureau (NWB)** | Licensing, regulations and permits on ground water use |
| **Department of Science andTechnology (DOST) PCAMRD** | Research and project assistance |
| **Local government units (LGU)** | Law enforcement |
| **Philippine Institute for Development Studies (PIDS)** | Research and policy studies |
| **Southeast Asian Fisheries Development Center (SEAFDEC)** | Research, training and extension |
| **Department of Trade and Industry (DTI)** | Policy formulation and implementation |
| **Board of Investments (BOI)** | Investment promotion |
| **University of the Philippines in the Visayas (UPV)** | Academic research, policy andeconomics |

The above agencies are those directly or indirectly involved in shrimp culture. But, each institution has no specific annual budgets and employees primarily assigned to shrimp culture alone. Budgets for management and coordination are integrated with the national budget of each agency while funding for research is allocated based on proposals submitted.

To date, coordination between agencies is low.

There is a need for all agencies concerned to come up with an effective and workable program which is holistic in approach integrating the watershed and the existing aquatic resources in the area.

The private sector on the other hand should take active participation in the program providing support and logistics.

## POLICY RECOMMENDATIONS

In the Philippines, there do not exist many laws and regulations specific for aquaculture management and protection. Most are general laws and implementation is very lax. Some laws were promulgated as reactions to existing problems such that before solutions could be found, the problem has done some irreversible damage.

To alleviate the existing shrimp problems the following policies/recommendations should be given preferential attention.

1. Prevention and control of aquaculture wastes

This could be attained through :

a. Promotion of semi-intensive culture with lower stocking density to reduce inputs;

b. Crop rotation of shrimp and milkfish;

The culture of mikfish during the months from November to March when salinity is high has proved to be effective in reducing organic load in ponds from previous shrimp crop.

c. Provision of reservoir/pond for water supply and treatment prior to water discharge.

2. Restricted use of antibiotics and other chemicals in aquaculture

3. Proper zoning of aquaculture areas based on scientific data taking into consideration the existence of other fishery resources in the area.

4. Promote the formation of small aquafarmers into association and cooperative or fishpond state for small farmers to implement co-management and self-management schemes.

5. Research on pond soil and water dynamics.

Promote researche on pond soil and water quality to determine the carrying capacity and effects of intensity levels of farming systems on pond soil and water quality.

6. HACCP

Promote aquaculture practices based on the Hazard Critical Control Point (HACCP) principle for product competitiveness in the world market.

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# SHRIMP CULTURE IN SRI LANKA
# THE BENEFITS, PROBLEMS AND CONSTRAINTS ASSOCIATED WITH THE DEVELOPMENT AND MANAGEMENT AND RESPONSES TO ADDRESS PROBLEMS

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## 1. INTRODUCTION

Sri Lanka does not have a tradition of aquaculture practice. There was virtually no aquaculture till the beginning of 1980. In 1968, the Ceylon Fisheries Corporation constructed ponds on a 2 ha tidal flat, but abandoned them in 1970 after the dikes were washed away. In 1977, a small shrimp farm covering 0.7 ha began operation in the shallow edge of the Batticoloa lagoon. (east coast). Realizing the importance and potential of increasing shrimp production and the availability of unpolluted brackish water and suitable land for pond construction (which are essentially unsuitable for agriculture or any other type of development activity, the government of Sri Lanka has paved the way for many private sector companies to come in to the shrimp farming industry by offering an attractive package of incentives including tax benefits.

In early 1980's a number of small scale entrepreneurs and a few large multinational companies embarked on shrimp farming. The industry grew slowly towards the beginning of 1990 giving to a total of 60 farms covering an area of 405 ha. Since then it grew rapidly over 2400 ha of area in the north western and western coastal belts. Of the total farm area of 2400 ha, ponds have been developed over an area of 1600 ha. 970 shrimp farms were recorded in 1996 with extents ranging from 0.5 ha to 200 ha. Of the 970 farms 589 farms have been recognized as unauthorized establishments operating without proper approvals.

**Table 1: Size, number and extent of the approved shrimp farms in North Western and Western coasts of Sri Lanka**

| Size of the farms(ha) | No. of farms | Extent (ha) |
|---|---|---|
| < 2.0 | 219 | 135.00 (7.42%) |
| 2.0 - 4.0 | 83 | 269.40 (14.82%) |
| 4.0 - 10.0 | 51 | 364.40 (20.10%) |
| 10.0 - 20.0 | 14 | 234.80 (12.91%) |
| 20.0 | 14 | 806.40 (44.40%) |
| | | **Total 1810.00** |

(The percentage extent of the total area developed is given in parenthesis).

Ministry of Fisheries of the North-western Provincial Council estimates a total of 589 unauthorized farms that have been developed over an area of 600 ha,. indicating the small size of these farms. Disetribution of shirmp farm in the northwestern coast is given in Figure 1.

It is believed that this rapid expansion of the industry over the past few years created many environmental problems and user conflicts. Government plans are, however, to expand the industry into north east and south over a guesstimated potential area of 6000 ha (Samaranayake, 1986).

## 2. BENEFITS OF SHRIMP CULTURE

### 2.1 Macro-economic benefits of shrimp culture

The share of shrimp aquaculture production to the total fish production in Sri Lanka ranged from 0.54% to 1.4 % between 1992 to 1996. In the fisheries sector shrimp comprises the largest quantity of any export product and earns the highest amount of foreign exchange. In 1980's the quantity exported ranged between 1300 mt and 2600 mt, the highest quantity exported being in 1984. In 1984 the production of cultured shrimps were 10 mt and contributed 0.4% to the total value of shrimp exported. Since then both the cultured shrimp production and percentage contribution to the total volome of srhimps exported increased towards mid 1990, to 3555 mt and 90% respectively. This indicates the importance of the shrimp culture industry in shrimp exports.

**Table 2: Shrimp exports and percentage contribution to the total fishery exports**

| Year | Quantity Exported (mt)Value | (Rs. million) | %contribution to the totalfishery exports in value. |
|---|---|---|---|
| 1992 | 1246 (1121.4) | 613 (551.7) | 42.31 |
| 1993 | 1426 (1283.4) | 808 (727.2) | 33.90 |
| 1994 | 2301 (2071.0) | 1650 (1485.0) | 45.12 |
| 1995 | 2781 (2503.0) | 2153 (1937.70) | 53.00 |
| 1996 | 3555 (3199.5) | 2365 (2128.50) | 51.60 |

Source: Custom Statistics

(The cultured shrimp production and value was calculated on the basis of 90% contribution to the total shrimps exported and given in parenthesis).

For the shrimp culture industry several imputs are being imported.

The main imported inputs in the shrimp farming industry are as follows;
1. Feed
2. Paddle wheel aerators
3. Pump
4. Generators

Feed is the most important and expensive input in the shrimp culture operation. The shrimp industry in Sri Lanka largely depend on the imported feed. As feed contributes 50 % - 60% of the total cost of production of shrimps, feed becomes the single most important imported input in shrimp culture.

**Table 3: The quantity and value of shrimp feed imported**

| Year | *Quantity of feed imported (mt) | Value of import (Rs. million) |
|---|---|---|
| 1992 | 2018.5 | 121.11 |
| 1993 | 2310 | 150.11 |
| 1994 | 3728 | 261.00 |
| 1995 | 4505 | 360.50 |
| 1996 | 5760 | 460.70 |

* Quantity of feed calculated on the basis of 1:1.8 conversion ratio.

**Table 4: Cost of imported inputs for shrimp culture for the period 1992 - 1996**

| Inported Inputs | Value (Rs Million) | %of the Total Value of Imports |
|---|---|---|
| Feed | 1353.42 | 72.94 |
| Paddle wheel aerators | 320.00 | 17.25 |
| Pumps | 40.00 | 2.16 |
| Generators | | |
| Large-scale Farms | 54.00 | 2.91 |
| Small-scale Farms | 88.00 | 4.74 |
| **Total** | **1855.42** | **100** |

For the period from 1992 to 1996 the total value earned as foreign exchange from the cultured shrimp export trade was Rs. million 7447 . The net earnings as foreign exchange from the cultured shrimp exports for the period from 1992 to 1996 amounted to Rs. million 5591.60.

### 2.2 Local benefits

According to a rough estimate the total number of direct employment generated due to the shrimp culture industry is around 20,000. The following supporting industries for the shrimp culture industry have been developed over the past five years in north western and western coastal belts of Sri Lanka.

**Table 5: Supporting industries developed in the Northwestern coast for shrimp culture industry**

| Supporting Industry | Number Of Establishments |
|---|---|
| Line outlets/producers | 21 |
| Fibreglass manufacturers | 05 |
| Feed outlets | 48 |
| Machinery supply and repair facilities | 14 |
| Hardware stores | 12 |

Source : Ministry of Fisheries and Women Affairs, Northwestern Provincial Council)

It has been estimated that another 20,000 indirect employment opportunities have been created from these supporting industries and part-time labourers for construction of ponds and other infrastructure facilities in the shrimp farms. The shrimp culture industry pays Rs. million 984 as wages and salaries annually for the direct employees. This direct and indirect employment represents 11 % of the total employment in the fisheries sector.

In addition to the direct and indirect employment opportunities certain infrastructure facilities have been developed in the shrimp culture areas as a result of the shrimp culture industry.

**Table 6: The infrastructure facilities developed due to the shrimp culture industry in northwest coast and their values**

| Infrastructure Developed | Value (Rs Million) |
|---|---|
| Roadways | 3.32 |
| Electricity supply | 72.30 |
| Wells | 0.42 |
| *Housing | 5.85 |
| **Total** | **81.89** |

* Including quarters for workers

(Source: Ministry of Fisheries and Women Affairs, North western Provincial Council)

According to the current rates the profits made by the shrimp farming industry is Rs.million 0.75 / crop/ ha. Thus the total extent of 1600 ha pond area would generate a profit of Rs. million 1200/crop/ ha from shrimp culture. The shrimp culture projects that have been approved by the Board of Investment (BOI) have to pay a tax payment of 15% as company tax but exempted from the tax on dividents. There is a 35% tax imposed on the dividents for the non BOI shrimp culture projects. For convenience, all shrimp culture projects have been considered as non BOI projects for the calculation of domestic value added of the shrimp culture industry and domestic value added return on domestic investment. The investment on the shrimp culture industry is Rs. million 4400 which is calculated at the which current rate of as Rs. million 2.75 /ha/crop including the working capital for the first crop. Value of the interest payments is calculated at 24% assuming 50% of the investment is in the form of domestic loan. No subsidies have been provided by the government or from any other institution as grants for the shrimp culture industry.

Table 7: Domestic value added and Domestic value added return on domestic investment of the shrimp culture industry

| Cost Component | Value (Rs Million) |
|---|---|
| Domestic wages and salaries | 492/crop* |
| Profits | 1200/crop |
| Taxes | 420/crop |
| Subsidies | nil |
| Interest payments on domestic loans | 264/crop |
| Domestic value added | 1848 |
| Domestic value-added return on domestic investment | 42% |

## 3. THE MAJOR TECHNOLOGICAL, SOCIAL ECONOMIC AND INSTITUTIONAL PROBLEMS AND CONSTRAINTS AND MEASURES TAKEN TO ADDRESS THEM

### 3.1 Problems and constraints related to the technology

### i. Lack of technical know-how in controlling disease out breaks in shrimp culture

Shrimp farming industry has experienced losses due to two major disease out breaks. Monodon Baculo Virus (MBV) in 1988 - 90 and the white spot disease in 1996. A few fish pathologists are available in the country, but no qualified trained personnel on shrimp diseases. Moreover no disease diagnostic facility is available for shrimp culture industry. Therefore delay in disease diagnostic process is inevitable in a disease out break situation.

In order to address this problem the shrimp culture industry has set up a laboratory facility for the farmers. Industrial Development Bureau of the Northwestern Provincial Council is also in the process of setting up of an Aquaculture Service Center to cater to the needs of the shrimp farmers and to coordinate institutions involve in the shrimp culture industry. In addition to these facilities the Ministry of Fisheries and Aquatic Resources has established an Aquaculture Extension Centre. Such facilities will be able to meet the basic needs of a shrimp farmer such as water quality monitoring and advice on commonly occurring diseases. These facilities are not fully equipped with for prompt diagnosis in the case of a major disease out break. Therefore the National Aquatic Resources Research and Development Agency (NARA) is in the process of training personnel on shrimp diseases and health management and developing a disease diagnostic facility with the assistance from FAO (TCP / SRL/6614).

### ii. Deterioration of water quality

The Dutch canal which is the main water source for the shrimp farming industry has faced a problem of deterioration of its water quality. Over the past decades many water quality parameters have changed towards the unfavourable levels. Increase in sediment sulphides nutrients and suspended solids were reported in the Dutch Canal (Corea et at, 1995) and may have facilitated the recent disease out-breaks caused by both SEMBV and *vibrio*.

The shrimp farming industry has taken steps to set up treatment systems and recirculating facilities within their shrimp culture facilities in order to maintain optimal water quality levels as a measure of reducing disease outbreaks. Small shrimp farmers, however are unable to devote a few ponds for this purpose due to the limited number of ponds they have for production. Many farmers have faced equity problem to set up such water treatment and recirculating facilities. Recently the government has provided Rs. million 100 for the industry through the banks for restructuring of farms in order to accommodate treatment and recirculating systems.

### iii. Inability to improve the carrying capacity of the main water source, the Dutch canal

The Dutch canal caters water and receive discharge effluents form around 150 shrimp farms that have been developed over an area of 1400 ha.

Among the several outlets connecting the Dutch Canal and the sea only two outfalls are functioning as partial openings. This closure of outfalls has restriction of water movement between sea and the Dutch Canal, preventing the natural process of renewing the Dutch canal water. The low water current levels (0.087 to 0.6 m / sec), Siriwardena and Dayartne, 1990) indicate the low renewal rate of the Dutch Canal. The low carrying capacity of the Dutch Canal as a water source for the shrimp farming industry has been reported by Siriwardena and Dayaratne, 1990. Several recommendations have been made to improve the renewal rates and carrying capacity of the Dutch Canal including dredging and opening of some of the sea outfalls or permanent basis. It has been estimated that a Rs. million 15 is needed for this purpose including opening of the Dutch Canal in to the sea at 5 points. Neither the government nor the shrimp culture industry could meet this expenditure.

### iv. Lack of a locally produced formulated pelleted feed for shrimp culture

The present shrimp culture industry is largely depend on the imported feeds. This component accounts for about 50% to 60% of the total operational cost and are sometimes in short supply. Hence, it is important that the country develops its own local feeds that are more suited to local conditions and cost less than imported feeds. The major constraints to the development of such a low cost formulated feed are the unavailability of low cost quality fish meal of relatively constant chemical composition and the lack of research into maximise the utilization of existing feed ingredients.

To address this problem Lever Aqua Products Limited, which operated two shrimp farms on the north western coast, manufactured a complete pelletised formulated commercial feed. This feed was sold at Rs. 60,000/mt against Rs.80,00/mt of imported feed. At present Lever Aqua Product Limited has terminated their shrimp culture projects.

### 3.2 Problems and constraints related to socio-economics

The main issue in relation to shrimp culture development is the user conflict between large- scale entrepreneurs and small scale farmers and between shrimp farmers and the community. This is because larger areas of scarce state land suitable for shrimp culture has been leased to large entrepreneurs, especially during the last decade. The main issues raised by the village communities living in the shrimp culture areas are:

i. the community has greater rights to state land than the "intruding" non-resident shrimp culturists; the community should therefore be consulted prior to leasing land for shrimp culture.

ii. by utilizing an excessive areas for shrimp culture, the community faces the problem of salt water intrusion in to their agricultural lands and domestic wells.

iii. clearance of mangroves has affected the community who make sustainable use of the mangroves.

iv. vi. loss of grazing land affects the traditional animal husbandry.

v. not provided sufficient employment opportunities to the community.

vi. by installing pumping stations in the sea to obtain sea water for hatcheries and grow-outs, shrimp culture projects have created mooring problems and inconvenience for local fishermen. In addition restrictions on fishing activities at the vicinity of shrimp farm projects has been imposed by the management of such farms for security reasons. Such restrictions have limited the fishing grounds of the artisanal fishermen.

vii. Loss of access ways to fishing grounds in the shrimp culture areas.

viii. Loss of ground water due to the extraction of ground water to dilute shrimp culture pond water in high saline areas.

ix. Loss of paddy fields and coconut cultivated land due to their conversion for shrimp culture and loss of employment and livelihood as a result thereof.

In addition to the communities living in the shrimp culture areas, the non-governmental environmental organization have launged a island wide protest against the existing shrimp culture industry and its expansion from northwestern coast in to the new areas, ie south, north and east. In addition to the above issues the issues raised by these NGO's are:

a) salterns in the shrimp culture area becoming unsuitable;
b) loss of scenic beauty;
c) loss of sensitive ecological habitats such as mangroves and mud flats;

d) loss of birds life. e. loss of social values. f. loss of traditional birth lands.

As a measure to solve the user conflict between large-scale and small-scale shrimp farmers , Ministry of Fisheries and Aquatic Resources imposed a ceiling on the maximum extent of state land that may be allocated to a single farmer. This ceiling was first set at 40 ha and subsequently brought down to 20 ha. These two ceilings, however never became a regulation.

Development of small-scale shrimp culture operations hand in hand with large-scale operations was another consideration to minimize the user conflicts and maximize social benefits. In view of this it has been suggested to operate a scheme that ensures several "satellite small farms" sited on a cluster farm concept, catering to and nurtured by a parent farm. Such an arrangement, it was hoped, would be capable of ensuring mutual benefits. This suggestion never came in to action.

The Central Environmental Authority has layed down a set of guidelines with respect to the environment / resources, project design and construction, operations and processing to which a shrimp culturists should adhere. These guidelines are formulated to prevent damages to the ecologically sensitive habitats, flood threats, salinisation of wells and agricultural lands, loss of grazing lands and to prevent social conflicts. An Environmental License is issued to a farmer once the construction is completed according to the guidelines. There are 589 shrimp farms operating without any kind of approval. This is mainly because of lack of and inability to monitor individual shrimp farms for their legality and proper operation according to the guidelines. This monitoring inability is mainly due to lack of man power and financial assistance provided by the budgetary allocations for planning and management of shrimp culture. The shrimp culture projects over 4 ha in extent are subjected to an Initial Environmental Examination (IEE) or to an Environmental Impact Assessment (EIA) process in order to prevent impacts on the environment. ( see section 6.2). Location of two or more projects each smaller than this size in contiguity has made this 4 ha limitation meaningless.

The zonal plan prepared in 1995 by the NARA in order to reduce the impact of shrimp culture on the environment had little effect on reducing the damage to the environment as it came into effect at a very late stage (mid 1995).

### 3.3 Problems and constraints related to institutions

The institutions (see section 9.0) that are involved in shrimp culture development and sustaining the production and economic returns suffers from the following main problems in order to function effectively to meet the objectives.

i. Lack of trained qualified personnel to solve technical problems listed above.

ii. Lack of man power and funds to monitor the growth and legality of the shrimp farms.

iii. Researchers are more keen on uplifting of their individual profiles for their carrier promotions than finding realistic solutions for the technical problems in the shrimp culture industry.

iv. Lack of an effective extension arm to educate the average farmer on the proper management of shrimp culture operations.

v. Lack of proper coordination between the institutions involved in the planing and management of shrimp culture industry result in duplication of work.

The NARA has taken steps to train personnel in the field of shrimp pathology and health management with the assistance of donor agencies such as FAO and ADB. Moreover she has made arrangements to formulate its research programme based on the national priorities with the involvement of the shrimp culturists. Ministry of Fisheries and Aquatic Resources in collaboration with the NARA and the Ministry of Fisheries of the Northwestern Provincial Council has organized a series of awareness programmes to educate the shrimp farmers on health management and disease control with the assistance of FAO. Monitoring of the growth of the industry has already been initiated with the GIS application with the assistance of FAO.

## 4. QUANTITATIVE ASSESSMENT OF THE IMPACTS OF SHRIMP CULTURE

The following are the resources that have been affected or thought to be affected due to shrimp culture.

- Loss of Ecologically sensitive habitats

- Loss of agricultural lands
- Loss of staple fish
- Spread of diseases
- Loss of ground water

### 4.1 Loss of ecologically sensitive habitats

It is widely believed that shrimp culture development is depleting the mangrove population in the coastal belt. Hence, mangrove has become the most important ecologically sensitive habitat that is affected by shrimp culture. Based on aerial photographs from the survey Department, the extent of mangroves in certain areas of the northwestern and western coasts viz Puttalam lagoon area is 1181.50 ha and 431.57 ha in 1981 and 1992 respectively (Amarasinghe and Perera, 1995). Only 37 % of the mangroves remained in the Puttalam lagoon in 1992. Of the lost 750 ha of mangroves in Puttalam area around 160 ha have been attributed to shrimp culture. According to the estimates made by the Ministry of Fisheries and Women Affairs of the Northwestern Provincial Council , 880 ha of mangroves have been lost due to shrimp farming in the Northwestern coast other than Puttalam area. No attempt has been made to value the cost of lost of this valuable ecosystem. The mangroves of the Puttalam area, however, are widely extracted for both subsistence and commercial purpose. In the mid 1980's about 55% of the households around Puttalam estuary use mangroves as fire wood (Amarasinghe, 1980).

### 4.2 Loss of agricultural lands

The main agricultural lands in the northwestern coastal belt that have been affected due to shrimp culture or converted for shrimp culture are paddy fields and coconut lands.

**Table 8: The extent and value of agricultural land their and crops lost due to shrimp culture**

| Crop | Extent Lost (Ha) | Value (Rs. Million) | Production Lost | Value (Rs. Million) | Labor Lost (Man Months)/Wages (Rs Million) |
|---|---|---|---|---|---|
| Paddy | 292 | 108.5 | 821.2 mt | 12.32 | 8760/22.0 |
| Coconut | 106 | 79.5 | 1.55 million nuts | 46.5 | 1192.5/3.56 |

The income that generates from one ha of paddy and coconut are Rs.75,000 and Rs. 439,000 per annum respectively against Rs. million 5 as income per annum generates from shrimp culture. The profits made by shrimp culture is around Rs. million 1.5/ha/annum. The profits made by a paddy farmer (Rs. 60,000 ha/annum) and by a coconut cultivator (Rs 153,500/ha/annum) have no comparison with the profits made by a shrimp farmer (Rs. million 1.5/ha/annum). This attractive profits made paddy cultivators and coconut cultivators to convert their paddy fields and coconut lands fully or partially in to shrimp ponds. The attrative profits from shrimp culture can not justify the conversion of these agricultural lands into shrimp ponds as these crops can not be valued once they are scarce. This converton into or damaging paddy fields and coconut cultivated lands for shrimp culture can not be justified.

### 4.3 Loss of staple fish

Milk fish has been identified as a fry resource capable of supporting commercial farming operations. Milkfish fry are abundant along the coastal waters of Sri Lanka. They occur from March to June and occasionally in October to November in shallow tidal pools in Mannar and in Puttalam (northwest coast) and Negombo(west coast) (Vilalus et al, 1982). It has been estimated that the fry potential of these areas is more than 600 million fry/ annum (Ramanathan, 1969). The annual catches, however, been much less: around 1.3 million between 1979 to 1983 (Thayaparan, and Chakrabarty, 1984). Since 1983, the fry collections were below 0.1 million. The milk fish fry collection programme was abandoned since 1989 as a result of the withdrawal of state patronage to inland fisheries and aquaculture and closure of Inland Fisheries Division of the then Ministry of Fisheries in 1990. Therefore no estimation could be possible of loss of this resource due to the loss of mangrove areas and tidal pools in the northwestern coast as a result of shrimp farming.

### 4.4 Spread of diseases

Two major disease out breaks were recorded in the shrimp farming industry. The first out break was occurred in 1988 to 1989 and the causative agent was Monodon Baculo virus (MBV). The production losses were recorded up to 75% from shrimp ponds. The loss was valued at Rs. million 186.62 as foreign exchange. The white spot disease was occurred in mid

1996 as the second out break in the industry. This affected the production in more than 90% shrimp farms in the northwestern coast causing a loss of Rs. million 1000 as foreign exchange. No incidents of mass kills of crustaceans were recorded in the natural waters due to these diseases. Mass fish kills however, were recorded in the Dutch Canal and suspected to be caused by hypernutrification (Corea et al, 1995). No coast estimates have been attempted of these losses.

### 4.5 Loss of ground water

The shrimp farms situated in the high saline area (Mundel to Kalpitiya) utilize ground water to control salinity in ponds. These farms use tube wells to extract fresh water to dilute high saline water in shrimp ponds. However less than 10% farmers utilize ground water for dilution of high saline water or depend solely on ground water as the main source to extract water for shrimp culture.

No records have been reported with respect to fall in the ground water level due to shrimp culture. However, the increasing demand for ground water in the agriculture sector and shrimp culture may lead to a resource conflict in the future. Therefore it is important to manage the utilization of this resource.

## 5.0 SPECIFIC SUBSIDIES FOR SHRIMP CULTURE INDUSTRY

Certain subsidies for the shrimp culture industry have been offered in the form of tax and duty rebates, soft loans, rescheduling loan repayments, differing installment payments etc. by the government institutions and banks, especially after the White Spot disease out break in mid 1996 which caused more than 90% of the farms out of production.

Since 1996 only around 25 % farmers restarted production due to lack of working capital and funds to restructure of the pond design to adopt various water management systems to minimize disease out breaks. According to the Central Bank of Sri Lanka sources, the shrimp culture industry is worth of Rs. billion 5.6. The loan capital up to July 1996 is Rs. million 672 and with interest it amounts to Rs. million 996. According to the small Business Prawn Farmers and Exports Association of Sri Lanka Rs. million 250 is needed as working capital to restart shrimp culture. To help the industry the following institutions have offered several subsidies.

**Board of Investment (BOI)**

- 5 years of full tax holiday.
- Concessionaire tax period at 15 % for 15 years after tax holiday.
- Duty excemption on imported goods.
- Excemption from Turnover tax on sales.
- Exchange control excemption.
- Concessionaire tax for expatriates at 15% for 5 years

To be entitled for the above incentives the following criteria have to be met.

- Minimum export requirement is 90% of turnover
- The minimum project cost should be Rs. million 2.5 for local investors and Rs. million 7.5 for foreign investors.
- Minimum of 50 employment opportunities for processing activities only.

In addition to the incentives given above the BOI has agreed to charge their annual fee in two installments.

Banks: Banks have offered the following concessions as a relief measure for the shrimp culture industry after the White Spot disease out break in mid 1996.

- Differed installments upto 15 months
- Rescheduled loan repayment by further 5 years at 18% interest rate.
- Reduced the interest rates from 5% from the original interest rate(18-24%).
- Capitalized the accumulated interest.

In addition to these concessions the government has granted a duty tax and turnover tax waiver on feed imports. According to the amount of feed imported in 1996 the saving due to this tax waiver will amount to Rs. million 46.0.

The following financial assistance has been given by the government and banks as mitigating or preventive measures of negative environmental impacts.

- Soft loans for installing water treatment systems at an interest rate linked to inflation rate, which is 6% at present. The funds for this purpose have been provided by KfW, a German funding agency, to banks. To date Rs. 20 million has been given for 10 farmers and processing of 25 more applications are in progress.

- The government of Sri Lanka has obtain the Cabinet approval to allocate Rs.million 100 as soft loans to set-up recirculation systems.

- The government of Sri Lanka has taken steps to impose a tax of Rs. 10 per each Kilo of shrimps exported in order to recover government loan, subsidy for environmental management and research and development. At the rate of export production in 1996, Rs. million 35.55 could be expected to generate from this proposed tax.

## 6. LOWS AND REGULATIONS PERTAINING TO SHRIMP CULTURE

### 6.1 Fisheries and Aquatic Resources Act

According to the Fisheries and Aquatic Resources Act, No. 2 of 1996 no person shall engage in, or cause any other person to engage in any fishery operation (including aquaculture) without a licence issued by the Director of Fisheries and Aquatic Resources.

### 6.2 National Environmental Act.

i. In addition to the above Fisheries Licence all aquaculture activities exceeding 4 ha should obtain an approval from the respective project approving agency according to the National Environmental Act, No. 47 of 1980, Section 232 as amended by Act, No. 56 of 1988.

ii. National Environmental Regulations, No. 1 of 1993 as contains in gazette extra-ordinary No. 772/22 of 24th June 1993 under the National Environmental Act No. 47 of 1980 describes the procedure for approval of projects.

According to these regulations all aquaculture projects exceeding 4 ha should submit an Initial Environmental Examination Report (IEE) (Projects between 4 and 20 ha in extent) or an Environmental Impact Assessment Report (EIA) (Projects over 20 ha in extent) to the project approving agency for environmental scoping. Upon receipt of the IEE or EIA project approving agency shall invite the public to make written comments. The comments received by the public will be forwarded to the project proponent for review and response. Upon receipt of such responses, the project approving agency shall with the concurrence of the Central Environmental Authority grant approval for the implementation or refuse approval for the implementation of the proposed project.

According to these regulations project proponent shall inform the project approving agency of any alteration to a, prescribed project approved under regulations for fresh approval or the abandonment of such approved project. In the case of abandonment the project proponent shall restore the site to a condition as specified by the project approving agency.

iii. In addition to these regulations there is a set of guidelines formulated by the Central Environmental Authority with respect to the environment /resources, project design and construction, operations and processing for coastal pond aquaculture.

### 6.3 Coastal conservation Act.

According to the coast Conservation Act, No. 57 of 1981 a permit is required for all development activities that are likely to alter the physical nature of the coastal zone. The coastal zone as defined by the Coast Conservation Act is " that area lying within a limit of 300 m landward of the mean high water line and a limit of 2 km seawards of the mean low water line and in the case of rivers, streams, lagoons or any other water body of water connected to the sea either permanently or periodically, the landward boundary shall extend to a limit of 2 Km measured perpendicular to the straight baseline drawn between the natural entrance points thereof and shall include the water of such rivers, streams and lagoons or any other body of water so connected to the sea.

There are no local or national non-governmental organizations involve in the planning and management of shrimp culture.

## 7. THE ROLES OF LOCAL AND NATIONAL SHRIMP PRODUCERS ORGANIZATION, NON-GOVERNMENTAL ORGANIZATIONS AND LOCAL GOVERNMENT

### 7.1 The role of local and national shrimp producers organizations

At present there are two organizations, namely Prawn Farmers and Exporters Association and Small Business Prawn Farmers and Exporters Association representing shrimp farming industry locally as well as nationally. The functions of these organizations are more or less similar and given as follows.

- Act as an umbrella that brings all the prawn farmers and exporters into one group that is able to fulfill the industrial and social needs for betterment of the industry.

- Act as a closely knit group to settle the problems of the industry ensuring discipline in the growth and development of the industry and also the technology.

- To request, canvass, hire consultants to help the industry in developing new technologies and transmitting the same to the industry.

- To request, canvass funds and financial support to develop the industry.

- To look after the interest of the shrimp farmers in the national policy working and coordinating such matters with the Ministry of Fisheries and Aquatic Resources.

- Representing the industry in the various national level committees associated with shrimp industry.

- Member of the Fisheries Advisory Council as per Fisheries Act.

### 7.2 The role of local government

The Scooping Committee of the Northwestern Province (NWP) which grants approval to Shrimp Culture Projects is formed under the Provincial Environmental Act of the Provincial Environmental Authority of NWP. All Environmental aspects of Shrimp Culture Projects are being looked into by the Provincial Environmental Authority, which is an authority administered by the Provincial Council of NWP.

The Provincial Fisheries Ministry of the NWP acts as a coordinating institution for the management, monitoring and socio-economic aspects concerning shrimp culture projects in the NWP.

The most important factors in this field attended to by NWP Ministry of Fisheries are the following factors.

1. Socio-economic aspects concerning site selection in consultation with the Divisional Secretary.

2. Scientific and Industrial aspects in consultation with the NARA.

3. Environmental aspects in consultation with the Environmental Authority - NWP.

4. Irrigation and Water Resources in consultation with the Irrigation Department.

Other aspects including ground water extraction, saline water intrusion to village lands, overcrowding of projects etc. in consultation with the respective institutions.

A general monitoring of projects is done eg. disease out breaks, pollution etc. is notified to the respective institution, after inspection. Coordination for awareness programmes is also effected by this Ministry with the assistance of qualified private consultants and state organizations.

General advice is available in this Ministry to prospective farmers and also those in activity.

Statistics regarding shrimp culture projects in the area is maintained by this Ministry.

An affiliated institution attending to Resources Development in the NWP managed under this Ministry is the Provincial Resources Foundation attending to aquaculture development aspects and also mangrove development and propogation in lagoon waters. Periodic instruction programmes are conducted in this field by this institution.

## 8. THE ROLE OF INTEGRATED COASTAL AREA MANAGEMENT SCHEMES

There were two studies under taken to formulated integrated resource management plans. One in the northwestern coast where shrimp farm industry is extensively developed and the other in the southern coast where much of public interest in terms of bath developing shrimp farms and preventing development. The NARA with the auspices of the Swedish Agency for Research Cooperation with Developing Countries (SAREC) launched a multidisiplinary project in 1990 to investigate the current state of the resource base in the Puttalam / Mundel estuarine system and associated coastal waters (northwestern coast). The aim was to understand the factors governing the productivity and sustainability of the resource base, which would enable the identification of the best management strategy and options.

This study has included management options to mitigate environmental degradations, resource over-exploitation, legal and institutional issues of shrimp aquaculture, ground water, mangrove and salt marshes and wildlife.

The following recommendations have been made to mitigate the environmental degradation, resource over exploitation and legal and institutional issues in order to observe sustainability of the shrimp farming industry.

(i) Enforce existing legislation, such as utilizing 20% of the pond area as sedimentation and treatment ponds.
(ii) Legalize all (existing) shrimp farms which meet the environmental regulations.
(iii) Illegal farms which do not fulfill environmental regulations should be closed.
(iv) Review, gazette and enforce the proposed aquaculture effluent standards, in view of the poor water quality parameters observed in the Dutch Canal.
(v) Continue the experiments in which seaweeds, seagrasses and molluscs are used to treat effluents, so the efficiency of such biological clean-up systems can be improved.
(vi) Consider regular opening of the sand bar at Udappuwa. This would improve the water quality in the Dutch Canal and also improve the natural re-stocking of the Mundel Lake.
(vii) Establish wither further delay a regular water quality monitoring programme for the Dutch Canal, the Puttalam lagoon and the Mundel Lake.

**However this scheme does not spell out the following:**

- How to address the difficulties in the enforcement of existing legislation.

- If enforce legislation to utilize 20% of the pond area as sedimentation and treatment pond, how a small-scale farmer having two ponds of one acre each fit into the scheme.

- What is to be done after closure of the illegal shrimp farms which do not fulfill environmental regulations.

It has been decided to establish an Inter Ministerial Committee (IMC) made up of the relevant central and provincial government departments and agencies, to implement the proposed programme. A project Implementation committee that is coordinated by the NARA will function under the IMC with secretarial support from the North Western Provincial Council.

**Table 9 : Important institutions dealing with shrimp culture**

| Institution And Role | Devoted Annual Budget (Rs Million) | Number Of Employees |
|---|---|---|
| • Ministry of Fisheries and Aquatic Resources Development<br>• Administration, legislation, management | NA | 07 |
| • National Aquatic Resources Research and Development Agency<br>• Research and Development | 1.7 | 08 |
| • Provincial Environmental Authority, NWP<br>• Environmental Legislation | N/A | 06 |
| • Ministry of Fisheries, NWP<br>• Provincial Administration, Management and Monitoring | N/A | 06 |

NA: No committed allocation is made for this purpose. Funds are being utilized from the budgetary allocation depending on the needs.

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# ON FARM QUALITY ASSURANCE FOR SHRIMP PRODUCTION IN THAILAND

by

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## Abstract

Intensive marine shrimp farming has been practiced for some 10 years during which period shrimp culture expanded rapidly along the coastal provinces of the country. Aquatic pollution due to effluent discharges and encroachment of culture areas into various ecosystems have been associated with the deterioration of coastal environment and mangrove destruction. Drug (and antibiotic) residues in shrimp flesh have also been found from time to time, causing in a few cases the rejection of products by importers. Mass mortalities caused by water pollution and diseases have occurred in many culture areas which have led to decrease in production and crop failures.

Department of Fisheries (DOF) has had many programme for marine shrimp farming sustainability. First, mobile units for technical services and disease inspection at farming sites have been organized and deployed by coastal aquaculture stations and centres. Water quality, red tide and farm sanitation monitoring programmes have been organized and scheduled in line with EU regulations. DOF has been appointed by the Government as the competent authority for export quality control of fisheries products to the EU markets. Raw materials as well as finished products are being inspected for quality and safety to consumers. Environmentally sustainable farming systems such as water recirculation, semi-closed water systems and biological treatment procedures have been studied and demonstrated by DOF. It is hoped that these measures could help in ensuring the sustainable farming of marine shrimp and producing high quality products.

## 1. Introduction

Marine shrimp farming in Thailand has been practised for the last 70 years (Tookwinas, 1995). However, the technology of intensive marine shrimp farming has expanded significantly along the coastal provinces for about 10 years. At the present time, Thailand has become the leading country in cultured shrimp production (153,000 tons in 1991, 163,000 tons in 1992, 168,000 tons in 1993 and 250,000 tons in 1994) (World Shrimp Farming, 1990-1994) with a total production area of approximately 71,887 ha, and 20,027 farmers in 1993 (Tables 1 and 2). The most important species is Black Tiger shrimp, Penaeus monodon . More than 90 percent of marine shrimp farming production has been exported in the form of "frozen headless" and "shell on" products. The importing countries are United States, Japan, European countries, Taiwan (Province of China) and Canada.

Table 1 Marine Shrimp Farming; Area and Number of Farmers in Thailand 1985-1993

| Year | Number of Farmers | Total ProductionArea (Ha) |
|---|---|---|
| 1985 | 4,939 | 40,769 |
| 1986 | 5,534 | 45,368 |
| 1987 | 5,899 | 44,770 |
| 1988 | 10,246 | 54,778 |
| 1989 | 12,545 | 71,165 |
| 1990 | 15,072 | 64,606 |
| 1991 | 18,998 | 75,332 |
| 1992 | 19,303 | 72,796 |
| 1993 | 20,027 | 71,887 |

Source : Fisheries Statistics (1994)

Table 2 World Cultured Shrimp Production from 1990 to 1994.

| Countries | Production (MT) | | | |
|---|---|---|---|---|
| | 1991 | 1992 | 1993 | 1994 |
| Thailand | 153,000 | 163,000 | 168,000 | 250,000 |
| Ecuador | 100,000 | 95,000 | 90,000 | 100,000 |
| Indonesia | 140,000 | 130,000 | 80,000 | 100,000 |
| India | 35,000 | 45,000 | 60,000 | 70,000 |
| China | 145,000 | 140,000 | 50,000 | 35,000 |
| Vietnam | 30,000 | 35,000 | 40,000 | 50,000 |
| Bangladesh | 25,000 | 25,000 | 30,000 | 35,000 |
| Taiwan (Province of China) | 30,000 | 25,000 | 25,000 | 25,000 |
| Philipines | 30,000 | 25,000 | 25,000 | 30,000 |
| Other | 45,000 | 46,000 | 54,000 | 63,000 |
| Total | 733,100 | 729,000 | 622,000 | 758,000 |

Source : World Shrimp Farming, in 1994

## 2. The factors of success of marine shrimp farming in Thailand

Thailand has been raising marine shrimp for a long time: traditional or extensive culture of marine shrimp has been practised over the past 70 years. About 20 years ago, DOF succeded in hatchery production of marine shrimp especially of the species *P. monodon* (Tookwinas,1991), and the farmers were encouraged to introduce additional stocking of shrimp fry in the traditional ponds; this type of culture is called semi-intensive. Then, intensive marine shrimp farming has developed during the last 10 years. The expansion of culture area and increase in production have occurred very rapidly. Thailand has become the leading country in marine shrimp production from farming since 1991. Kongkeo (1994) stated the key factors for the sucess of marine shrimp farming in Thailand as follows:

### 2.1 Suitable sites

Thailand is in the tropics and has plenty of coastal areas suitable for shrimp farming.

### 2.2 Availability of wild broodstock

Tiger prawn (*P. monodon*) is a local shrimp species in South East Asia. Therefore, wild broodstocks are available for hatchery production of shrimp fry. DOF has had a programme for restocking shrimp fry in the coastal waters of around 200-300 million fry every year. Some farmers, in cooperation with DOF, also restock some portion of their shrimp production after harvesting from the farms in order to maintain or supplement the natural population of tiger prawn.

### 2.3 Long experience in aquaculture

The shrimp farmers have a long experience in aquaculture. They are also enthusiastic to learn and practise advanced technologies. They always have new ideas for development or modification. And they are eager to run these experiments by themselves. The present success of Thailand in this industry is testimony to the persistence and ingenuity of Thai people in utilizing applied science to its utmost potential (C.P. Aquaculture, 1994)

### 2.4 Well developed infrastructure and supporting industries

Marine shrimp industries require a lot of infrastructure and supporting industries. Infrastructure such as transportation, electricity and telephone communications are very important for the rapid development of shrimp industries and are very well developed in Thailand. Thailand also has adequate supporting and ancillary businesses such as construction materials, heavy machines, feed mills, shrimp fry hatcheries and food processing plants which have helped the development of the shrimp industries.

### 2.5 Small-scale industry.

Marine shrimp culture in Thailand is a rather small-scale industry. Most farms are small with an area ranging from 0.16-1.6 ha which is quite convenient for pond construction and operation. Also average investment cost is low. Thailand is originally using techniques of backyard hatcheries which are managed with simple but efficient technology mainly by farmers with little education but produce more than 80% of national shrimp fry production.

### 2.6 Lower environmental impact.

Thailand has a coastal line of about 2600 km. Marine shrimp farming has expanded *scattered over* every coastal province of the country. The effluent of shrimp farmers can be easily dispersed. Previously, mangroves were invaded for shrimp farm construction. This is due to the convenience to get water supply and vast areas can be destroyed in the construction of aquaculture ponds. It is now accepted that the destruction of mangroves may destroy not only fish and crustacean nursery grounds but also natural flood and storm protection barriers (Sakthivel, 1985). The area which is considered the best suited for shrimp farming are rice fields in coastal areas. These rice fields are at low productivity and contain very high content of clay silt which is suitable for pond construction and prevention of seepage.

According to recent information, only 17.25% of mangroves were used for shrimp farming all over the country (Research Council of Thailand, 1995 and Charuppat and Ongsomwang, 1995). DOF has the determined policy to move out all farms presently located in mangrove areas to other suitable locations. The government also has the regulation for shrimp farming registration and effluent regulations in order to prevent harmful effects on the coastal environment.

## 3. Major Constraints

Some major constraints of the marine shrimp farming industry in Thailand are the effects of effluent which have been a subject of increasing attention in recent year. Pollution loading, including release of toxic materials, have been quoted as causing a deterioration in the state of coastal natural resources and the environment. Another concern are the mangroves which have been destroyed for farm construction.

Several research papers have provided details about effluent quality and pollution loading from marine shrimp farms. Songsangjinda and Tunvilai (1993) stated that the pollution loading from an intensive tiger shrimp farm in Ranot, Songkhla Province, Southern Thailand were as follows: total nitrogen 2.02 kg/ha/day, total suspended solid 532.2 kg/ha/day and chlorophyll 0.11 kg/ha/day. Tookwinas et al, (1994) and Satapornvanit (1993) discovered that the total loading from marine shrimp farming in Kung Krabaen Bay, Chanthaburi Province, eastern Thailand, were as follows: water discharge 67,400 ton/ha/crop, total nitrogen 5 ton/ha/crop, total organic carbon 89.6 ton/ha/crop. B.O.D.$_5^{20}$ 1,821 ton/ha/crop and sludge (wet weight) 134 ton/ha/crop.

Charuppat and Ongsomwang (1995) reported utilization patterns of mangrove areas by three main categories in Thailand by synthesizing satellite image data of 1993, (Landsat Tm, 1:50,000): shrimp farms 6,500 ha.(17.25%); land settlement and other purposes: 138,785 ha.(37.31%) and the remaining mangrove area: 168,028 ha.(45.2%). The data show that only a small portion of mangrove area has been utilized for shrimp farm development. However, shrimp farms in mangrove areas are the main portion of culture areas in the country. DOF has foreseen the problem and, thus, has the policy to move out all shrimp farms which are in mangrove areas to private land or unproductive areas through a licensing process.

Macintosh and Phillips (1992) compared the quality of shrimp farm effluent with wastes from other potential sources of pollution. This comparison shows that the pollution potential of shrimp farm effluent is considerably less than that of domestic or industrial waste water. However, the waste from intensive shrimp farms has still contributed to many effects due to excess feeds, fertilizers, chemicals and antibiotics. One major problem of shrimp farm effluent is its dilute but high volume nature (Muir,1982). Tookwinas (1994) suggested that the suitable treatment process would be a combination of chemical and physical treatment. However, more research is recommended.

Chemicals and drugs are widely used in marine shrimp culture for prevention or treatment of diseases, such as feed additives, disinfectants, pesticides, or for soil or water treatment. Several compounds in use pose a potential threat to shrimp health and product quality (Macintosh and Phillips,1992). Widespread use of oxytetracycline and oxolinic acid in South East Asian countries has resulted in the development of resistant strains of *vibrio* which has made treatment of *vibrio* infections extremely difficult (Nash, 1990). Antibiotics and some other chemicals may leave residues in shrimp flesh, which may lead to rejection of products in export markets.

## 4. Government policies and regulations

The exported production of cultured marine shrimp has generated foreign exchange earnings of about 45,000 million baht each year, which is a very high portion among export commodities. The environmental problems faced by the shrimp culture industry are a major constraint to its future growth. The government and shrimp farmers should strengthen such very important measures as environmental impact assessments and mitigation measures. Farmers would be required to place emphasis on providing a healthy environment for the shrimp and make greater efforts to control adverse environmental impacts outside the shrimp farm. Planning and environmental impact assessment are needed to maintain good product quality and preserve the coastal environment. This means that the farmers can culture shrimp with a high survival rate, very good feed conversion ratio and less impact on the environment. Then, they can farm shrimp in a sustainable manner similar to other agricultural crops. The government policies cover the following aspects:

### 4.1 Integrated coastal zone management and mangrove reforestation

The concept of coastal zone management (ICZM) has been adopted as an approach for coastal natural resources conservation and environmental protection. ICZM is a multi-sectoral and integrated approach and its techniques are used, inter alia, as the tools to address the conflicts that have arisen between different users and uses of coastal areas, such as tourism, freshwater agricultural area, and mangrove conversion. Local people will be trained and given responsibility for the development of their coastal area, both in development planning and implementation. ICZM approach can be seen as having the following major components:

1) Carrying capacity of receiving waters will be determined for each area of the coastal zone in order to minimize the effect of shrimp effluent, achieve good product quality and protect the coastal environment.
2) People of coastal communities will be trained to enhance their knowledge and skills on appropriate techniques of aquaculture, coastal resources conservation and coastal environment protection.
3) Virgin mangrove areas will be strictly preserved by the government. Suitable areas must be replanted with mangroves. The communities should be encouraged to take responsibility for mangrove reforestation and protection.
4) At the present time, there are about 20,000 shrimp farmers in the country. The government would like to promote the establishment and strengthening of shrimp farmers' associations or cooperatives in every location or coastal province. The associations are well placed to take on responsibility for mangrove conservation, enforcement of effluent regulation and for technology transfer of technical service from government offices. Farmers can also share and disseminate appropriate technologies among themselves.
5) Experiences with marine shrimp culture problems suggest that sea water quality is the main limiting factor for the industry. Farmers in many areas face water pollution from shrimp farming itself as well as from domestic and industrial wastes. Farmers should take joint responsibility to manage the use of sea water since the most efficient way for sharing the sea water supply is through farmers' association.

### 4.2 Farm design and management techniques

Suitable farming site, appropriate technology for farm design and good farm management practices are the main factors of success in this business. In fact, many farmers were over-stocking their ponds resulting in low survival rates (S.R.); very high food conversion ratio (FCR) values and very low production. The effluent had high concentration of pollutants which directly affected the environment and water quality in the coastal areas. Subsequently, the pollution problems affected the farmers themselves. The ideal farm planning and operation must be based on the following:

a) Water storage and treatment area should be around 40% of culture area
b) Stocking density of shrimp fry should not be above 50 PL/$m^2$
c) Culture technique would be managed to get F.C.R. of 1.6 and S.R. of 80%.
d) B.O.D.$_5^{20}$ in effluent should be less than 10 mg/l

### 4.3 Sea water irrigation and farmers' associations

The concept and purpose of sea water irrigation should be as follows:

a) To provide appropriate water quality to farming area.
b) To design and redesign farming system with recent and appropriate farming technology.
c) To train farmers about farming management technique to obtain better survival of shrimp.
d) To provide treatment techniques and facilities for farm effluent.
e) To form farmers' associations to collectively operate the sea water irrigation system. .

After completing the sea water irrigation system, the farmers' association needs to be formed in order to look after the system and share the water supply among the members. The water available in storage will be supplied to every farm in the system. Then, the water treatment facilities would be also shared among the farmers. The day-to-day operation of the sea water irrigation system must be done by the farmers' association. The farmers must also be responsible for the operating and maintenance costs of the system through the association.

### 4.4 Treatment of shrimp pond effluent

Treatment of shrimp pond effluent offers considerable potential for reducing impacts on water quality in the external environment (Macintosh and Phillips, 1992.). One major problem is the dilute but high volume nature of aquaculture effluent in comparison with traditional forms of wastewater (Muir, 1982). Treatment can be based on physical, chemical and biological methods. Physical methods include filtration or settlement. For example, one hectare of culture area requires a settling pond to handle 900 cubicmeter of shrimp pond effluent per day (Rubel and Hager, 1979). The same authors also concluded that filtration was the best treatment process to remove suspended solids with less than 10 mg/L. However, the costs are likely to be high and prohibitive.

Many experiments for shrimp farm effluent treatment have been conducted. Tookwinas (1995) conducted laboratory tests on chemical treatment methods. The results have shown that calcium oxide (CaO) 0.3 mg/L or Zeolite 10mg/L with aeration can reduce the effluent concentration down to the acceptable level within 24 hrs. The efficiency was about 89% and 94% for CaO and Zeolite, respectively. Experiments on the use of seaweed cultivation in drained shrimp ponds was conducted at Chanthaburi and Songkhla Provinces (Daroonchoo, 1991), (Chaiyakam and Tunvilai, 1992). Ammonia-nitrogen and B.O.D. were absorbed by seaweed in 24 hrs at about 100% and 39%, respectively. Experiments using artemia and mussel were also conducted (Tunvilai And Tookwinas,1991 Chaiyakam and Tunvilai, 1992), showing that mussels could decrease ammonia-nitrogen and B.O.D. in effluent by about 67% and 7.7% in 24 hrs., respectively. The development of closed systems and recycle systems for marine shrimp culture may be possible. The experiment using herbivorus fish such as mullet, seaweed such as gracilaria and mollusc such as mussel were conducted by culturing these species in drainage ponds as a biological treatment system. The sea water could be purified and recycled back to the culture pond (Tunsutapanich et al., 1995). However, further research is to be recommended in order to obtain additional information on technical aspects.

Therefore, basic potential treatment methods for shrimp pond effluent can be further developed by combining physical, chemical and biological processes as shown in Table 3. More research in this area is recommended.

Table 3 Potential treatment methods (Modified from Macintosh and Phillips, 1992; Tookwinas, and Neumhom 1995)

| Method | Benefits |
|---|---|
| 1. Mussel and oyster culturing | Removal of particulate organic matter and phytoplankton from water column |
| 2. Brackishwater fish culturing | Removal of particulate organic matters (Mullet and tilapia) |
| 3. Red algae culturing | Removal of dissolved nutrients (N and P) |
| 4. Sedimentation pond plus adding CaO and Zeolite | Removal of particulate organic matters |
| 5. Mangrove | As wetland to absorb nutrients and increase the settling rate by mangrove trees |

### 4.5 Government regulation

Marine shrimp culture along the coast earns foreign exchange of significant economic importance to the country. Shrimp farming generates employment and income benefiting the national economy. DOF has very strong policies to promote shrimp farming as a sustainable activity/industry. The plans and policies can be summarized as follows:

4.5.1 Marine shrimp farming area all over the country should not exceed 76,000 ha.

4.5.2 Regulations for shrimp farming in Thailand, announced by DOF on November, 1991 under Fisheries Act 1947, are as follows:

1) Shrimp farmers must be registered with DOF Fisheries District Officers.
2) Shrimp farms over 50 rai (8 ha) must be equipped with waste water treatment or sedimentation ponds not covering less than 10% of the pond area.
3) Water released from the shrimp pond area must contain a $BOD_5^{20}$ not to exceed 10 mg/l.
4) Saltwater must not be drained into public freshwater resources or other agricultural areas.
5) Sludge or bottom mud sediment should be kept in a suitable area and should not be pumped out to the public area or canal.

### 4.6 Strengthening shrimp hatchery and farm registration

Shrimp hatchery and shrimp farm registrations must be strengthened in order to get the required information about culture activities. The law enforcement of effluent regulation can be done effectively along with the registration.

### 4.7 Monitoring programme and antibiotic residue inspection.

The coastal aquaculture centers and stations under DOF in every coastal province have an environmental monitoring programme in marine shrimp farming areas. The purpose is to collect environmental data and provide technical advice to farmers. Samples of shrimp from grow-out ponds are also collected for antibiotic residue analysis. Samples of finished frozen products are also inspected for sanitary and antibiotic residue certification before exporting.

### 4.8 Research programmes

Many research programmes have been carried out during the last 10 years. At the present time, the research plan places emphasis on;

- Rearing of spawners in earthen pond and related genetic improvement research.
- Environmental management in grow-out ponds.

## 5. Monitoring programme

The environmental monitoring programme covering shrimp farming areas has been conducted since 1989. The programme has been organized under the Coastal Aquaculture Center (CAC) and Coastal Aquaculture Station (CAS) of Coastal Aquaculture Division, (CAD) the Department of Fisheries. At the present time, the monitoring programme operates 22 units under CAC/CAS with the following tastes and purposes:

5.1 Monthly survey of farm hygiene records, whose details are shown in Table 4 (Mo. 1) These records provide general information about sanitary conditions in the shrimp farms.

5.2 Bi-monthly survey of records of chemical and drug uses, and the occurrence of plankton in farming areas such as in brackish water canals and estuaries as shown in Table 5 (Mo.2.1.).

5.3 Monthly collection of environmental data from shrimp culture ponds as shown in Table 6 (Mo. 2.2).

5.4 The water quality in shrimp farming areas is being surveyed every three months; details are shown in Table 7 (Mo. 3).

Each environmental monitoring programme unit is responsible for one province. All survey records have to be sent to CAD in Bangkok every month (Forms Mo.1, Mo.2.1 and Mo.2.2) and every three months (Form Mo.3). This monitoring programme has been approved in conformity with the EU regulations for importing aquatic products.

## 6. Antibiotic residue inspection

The antibiotic residue inspection, emphasizing oxytetracyclin and oxolinic acid, has been scheduled in line with EU regulations, and following the problems associated with the rejection of shrimp exports. Inspection units have been established in every CAC and CAS (except Narathiwat Coastal Aquaculture Station) since 1994. The shrimp farming area in Narathiwat province is under the unit of Pattani Coastal Aquaculture Station. Analytical equipment such as High Performance Liquid Chromatography (HPLC) is used for testing procedures. Since the beginning of 1996, HPLC is operated effectively in every unit. Table 8 shows initial results of antibiotic residue inspections from 17 units.

## 7. Future opportunities

It is fair to say that the future of the shrimp farming industry in Thailand looks quite promising due to many factors and/or advantages. Kongkeo (1995) stated that, as mentioned previously, Thailand has the most favourable agro-climatic conditions for shrimp culture: wild broodstock is easily available; infrastructure facilities and supporting industries are well developed; and finally, the shrimp farmers have had a long experience in aquaculture. They are also enthusiastic to learn and practice advanced technologies and always have had new ideas for development and modification. The government sector, especially DOF has paid a lot of attention to develop the industry for sustainability. Therefore, undoubtedly, Thailand can still maintain its position as the top leader of shrimp farming production in the world.

Table 4 Farm Hygiene Record (Mo1), September 1995 (Example for some provinces)

| Items | Provinces | | | | | |
|---|---|---|---|---|---|---|
| | Trat | | | | | |
| 1. Cultured Area Surveyed(ha) | 25.68 | 1.36 | 13.36 | 24.70 | 1.12 | 4.63 |
| 2. General information | | | | | | |
| 2.1 Farm sanitation | 1 | 1 | 1 | 1 | 1 | 1 |
| 3. House/storage | - | - | - | - | - | - |
| 4. Water sources | 1 | 1 | 2 | 1 | - | 2 |
| 5. Sanitation | - | - | - | - | - | - |
| 5.1 Ice for preservation | 1 | 1 | 1 | 1 | 2 | 2 |
| 5.2 Wash room | 1 | 1 | 1 | 1 | 1 | 2 |
| 5.3 Litter/Garbage | 1 | 1 | 1 | 1 | 1 | 2 |
| 5.4 Prevention | 1 | 1 | 1 | 1 | 1 | 2 |
| 6. Materials | 1 | 1 | 1 | 1 | 1 | 2 |
| 7. Farm management | 1 | 1 | 1 | 1 | 1 | 2 |
| 7.1 Cleanliness | 1 | 1 | 1 | 1 | 1 | 2 |
| 7.2 General culture | | | | | | |

Remark. Marking range ; Good (1) Satisfactory (2) Need some improved (3)

Table 5 Coastal aquaculture zone watching record (Mo 2.1), September 1995

| Provinces | No.of Farm | Chemicals and Drug Uses | TC MPN/100ml | FC MPN/100ml | Plankton Occurrence | Disease |
|---|---|---|---|---|---|---|
| Satul | 8 | Oxolinic acid Vitamin Sulfadiazine | 9-1100 | 3.6-1100 | Oocystis,Rhizosolenia, Microcytis, Peridinium, Lauderia, Oscillatoria, | Vibriosis, Zoothamnium |
| Trad | 22 | Vitamin oxolinic acid Oxytetracyclin Vitamin C | - | - | - | - |
| Trang | 16 | Oxytetracyclin, Bxc, Oxolinic acid iodine Norfloxaxin | 21-75 | 28-95 | Chlorella, Dincflgellage, Oocystis, Oscillatoria, Rhizo-solenia, Gymnodinium | - |
| Prajubkirikhan | 33 | Sulfamate, Hydroxy Sulfadiazine,oxytet-racyclin | <3->2400 | <3 | - | - |
| Narathiwat | 1 | - | - | - | Brachiomis, Copepod, Aeartia | - |
| Phuket | 5 | - | 4-240 | 4-240 | Oscillatoria, Navicula, Coscinodiscus, Grammato-phora, Oocystis, Skeletonema Favella,Copepod, Alexandrium, Rotifer, Streptotheca, Peridinium, Scenesdesmus, Green algae | - |
| Ranong | 5 | - | - | - | Oscillatoria,Nauplius,Rotifer, Tintinnopsis,Gyrosigma, Oocystis,Prorocentrum, Nitzchia,Noctoc,Holopedium, Scendesmus,Pseudocunotica. | - |
| Chuntaburi | 5 | Oxytetracyclin, oxolinic,acid,chlorine,Vitamin,BK C,Norfloxaxin | 573.3>10,333.3 | 430>10,333.3 | Dictyosphaerium,Pleurosigma Gyrosigma,Coscinodiscus Nauplius,Scenedesmus, Coelastrum,Microcystis, Cyctotella,Rotifer,Oocystis, Copepod,Prorocentrum, Unidentified,diatom,Perdinium Unidentified,diatom, Peridinium,Navicula,Phacus, Chlorella,Chamydomonas, Coelastrum,Dictyosphaerium, Rhizososolinia. | High suspended solid |
| Chachengsao | 6 | Oxytetracyclin,Sulfa, Norflxaxin | 70-2400 | 30->2400 | Spirulina,Oscillatoria,Lyngbya Chatomyolomonas, Schrolderia | - |
| Songkhla | 6 | Oxytetracyclin | 320-1620 | 25-240 | Oocystis,Rotifer,Spirulina, Nitzchia,Coscinodiscus, Gyelotella,Chroococcuss, Hyalotheco,Rotifer,Copepod, Nitzschia, Planktonella,Oscillatoria, Lyngbya | |
| Samuthsakhorn | 4 | - | - | - | | - |

Table 6 Water quality in shrimp pond (Mo 2.2) Seotember, 1995

| Province | No .of Farms | Stocking Density | DO mg/l | BOD mg/l | Visibility cm | Salinity ppt | $NH_3$-N mg/l | $NO_2$-N mg/l |
|---|---|---|---|---|---|---|---|---|
| Satoon | 16 | 43-106 | 7.4-10.6 | 4.0-18.78 | 20-70 | 8-20 | 0.10-2.5 | 0.001-0.444 |
| Nakhonsrithanmarat | 4 | 62-125 | 4.0-7.2 | 3.74-12.48 | 13-38 | 29-34 | - | - |
| Trang | 17 | 50-63 | 5.1-8.1 | 2.9-5.4 | 20-60 | 6-27 | 0.240-1.300 | 1.200-5.170 |
| Rayong | 5 | 41.55 | 2.5-6.5 | - | 20-130 | 4-10 | 0.1-1 | 0->1 |
| Khunggraban Center | 7 | 50-96 | 4.2-6.6 | 1.8-8.3 | 18-30 | 8-14 | 0.0235-1.5394 | 0.0440-0.6692 |
| Surathani | 24 | 54.7-83.3 | 2.8-8.6 | 0.1-6.0 | 25-70 | 1-19 | 0.20-2.60 | 0.05-1.00 |
| Narathiwas | 1 | 70 | 5.54 | - | 70 | 10 | - | - |
| Phuket | 5 | 71-104 | 8.4-14.6 | 6.0-20.5 | 25-45 | 18-27 | 0.01-0.56 | 0.016->0.33 |
| Ranong | 5 | 40.63-83.3 | 5.05-17.65 | - | 32-50 | 1-8 | 0.007-0.0750 | 0.0114-2.08 |
| Chantaburi | 5 | 44-66 | 7.0-10.0 | 5.7-8.9 | 20-28 | 3-4 | 0.0175-0.1093 | 0.0047-0.2248 |
| Songknla | 6 | 63-110 | 6.0-8.0 | 2.36-10.14 | 35-50 | 10-32 | 0.002-0.045 | 0.001-0.010 |
| Samuthsakrom | 6 | 43.3-78.13 | 5.0-10.2 | - | 5-20 | 3-10 | 0.05 | 0.05-1.0 |

Table 7 Water quality in farming zone (Mo.3) September 1994

| Province | No. of Samples | DO mg/l | BOD mg/l | NH3-N mg/l | $NO_2$-N mg/l | TC (HPN/100ml) | FC (HPN/100ml) | Red tide |
|---|---|---|---|---|---|---|---|---|
| Trang | 8 | 4.2-5.3 | 2.9-4.2 | 0.012-0.312 | 0.098-0.467 | 150-1100 | 150-1100 | - |
| Prajub-kirikhan | 7 | 6.5-8.8 | 2.15-5.6 | 0.001-0.064 | 0.001-0.009 | 48-668 | <3-460 | - |
| Rayong | 1 | 4.2 | - | 0.1 | 0 | - | - | - |
| Surathare | 7 | 3.9-5.6 | 0.1-2.4 | 0-0.03 | 0-0.02 | 27->1100 | 23->1100 | Alexandrium Noctiluca |
| Chacheangsao | 7 | 0.6-4.5 | 1.3-7.0 | 0.007-0.1746 | 0.0013-0.0174 | 1100->2400 | - | - |

Table 8 Results from antibiotic residue inspection unit (17 units) under DOF., MOAC. 1995

| Month/year | No. of sample | Results | | | | Remark |
|---|---|---|---|---|---|---|
| | | OTC | | OXO | | |
| | | Bio | HPLC* | Bio | HPLC* | |
| 10/1994 | - | - | - | - | - | OTC=Oxytetracyclin<br>OXO=Oxolinicacid<br>BIO=Bioassaytest<br>HPLC=High performance liquid chromatography<br>ND-non detectable |
| 11/1994 | 105 | - | ND | ND | - | |
| 12/1994 | 148 | +1 | ND | ND | +2 | |
| 1/1995 | 138 | +6 | ND | ND | ND | |
| 2/1995 | 86 | +4 | ND | ND | ND | |
| 3/1995 | 175 | +1 | ND | ND | ND | |
| 4/1995 | 171 | +1 | ND | ND | ND | |
| 5/1995 | 155 | +1 | ND | ND | ND | |
| 6/1995 | 213 | +1 | ND | ND | ND | |
| 7/1995 | 309 | +3 | ND | ND | ND | |
| 8/1995 | 458 | +15 | ND | ND | ND | |
| 9/1995 | 347 | +19 | ND | ND | +1 | |
| Total | 2,305 | +42 | ND | ND | +3 | |

* HPLC analysis was operated only on unit from 17 units.

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# SHRIMP MARICULTURE IN THE UNITED STATES - ISSUES FOR SUSTAINABILITY

by

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## SUMMARY

The U.S. production of shrimp through aquaculture is tiny, but the U.S. plays an important role in the areas of culture technology development, feed production, and consultative services. The U.S. is also the largest importer of cultured shrimp in the world, and the world shrimp aquaculture industry is influenced by the U.S. markets. The U.S. environmental community is a leading voice advocating sustainable shrimp culture practices and the elimination of habitat loss and habitat restoration and the establishment and use of international standards of responsible conduct in the domestic and international shrimp culture industry.

The U.S. is a leader in the development of new technologies for shrimp culture. This is a time when more primitive technologies are beginning to be replaced with systems that favor the use of high health stocks produced from captive broodstocks, and more efficient production systems. The U.S. has invested substantially in shrimp farming research and development, and recognized fairly early that domestically only economically sustainable and environmentally sound production systems could prosper. The U.S. industry uses, and continues to work to develop, technology-based reliable, intensive and high rate production systems that yield quality products. This strategy is necessary in the U.S. for economic reasons, and the industry believes that in the long run these highly efficient systems will also become the low cost producers.

## INTRODUCTION

The United States plays a very important role in global shrimp farming, not because of its domestic shrimp production from aquaculture which is very small, but due to numerous activities that support shrimp aquaculture around the world, and due to its position in the global marketplace. The U.S. plays a major role in research and technology development, the export of feeds, equipment, brood stock and larvae and the dissemination of information. U.S. companies have also made substantial foreign investment in shrimp culture. Additionally, the U.S. exhibits considerable influence over world markets as the world's largest importer and consumer of shrimp.

Shrimp farming is not a major industry in the U.S. and accounts for only a small fraction of the world's production. Although there has been substantial interest in shrimp mariculture in the U.S. since the 1960's, various constraints have prevented it's widespread development. Most importantly, the continental U.S. has a less than tropical climate, and water temperatures are only appropriate for pond shrimp cultivation in a few southern states, and only for the warmest portion of the year.

Entrepreneurs, researchers and consultants from the U.S. have been developing and marketing shrimp technology since the early 1970's, contributing substantially to the rapid rise in the global industry. The U.S. supplies capital, feeds, equipment, brood stock and larvae, consulting, information and training to shrimp farms and farmers in most of the world. Shrimp is the most popular seafood item in the U.S. diet, and domestic sales of shrimp are double that of any other fresh or frozen product (Dore, 1994). Annual per capita shrimp consumption in the U.S. grew remarkably from 1.5 pounds in 1976 to 2.5 pounds in 1987 and has held steady at between 2.4 and 2.6 pounds since. (National Marine Fisheries Service, 1997). It is believed, however, that there is substantial latent consumer demand for shrimp in the current robust economy, but the product is not available (Fish Farming International, 1996)

Shrimp is the leading seafood product sold in every geographical region of the United States. Most purchases of shrimp in the U.S. are made by restaurants and institutions. Fully 80% of all shrimp eaten in the U.S. is consumed in restaurants where it constitutes 20% of all seafood sales. Shrimp also makes up about 50% of fish sales in retail outlets. (Clay, 1996).

With value added from processing, marketing, distribution and service shrimp accounts for more than $10 billion in U.S. consumer spending annually.

The U.S. is the world's largest consumer of shrimp, and although it has a large domestic production mostly from wildstock fisheries, it is also the world's largest importer of shrimp, and imports amount to about 81% of the total supply. About 50% of the imported shrimp are aquaculture-produced. According to official estimates (National Marine Fisheries Service, 1997), the U.S. imported 582 million pounds (264,000 metric tons) of shrimp in 1996 with a value of 2.5 billion dollars, 36% of the value of total edible imports. Of this quantity, about half came from aquaculture production.

## BRIEF HISTORY OF US SHRIMP CULTURE

According to a National Marine Fisheries Service summary (1992), as early as the 1940's various individuals in some of the southern U.S. states began experimenting with shrimp farming using captive stocks of native northern white shrimp, *Paneus setiferus*. The Bureau of Commercial Fisheries (now National Marine Fisheries Service) laboratory in Galveston, Texas began their work with the northern brown shrimp (*Paneus aztecus*) in 1963 that led to the "Galveston Method" for raising panaeids in large tanks. The first significant commercial ventures in the U.S. started in 1967 and were located in Florida. In one project several embayments were closed off with nets and stocked with juvenile shrimp. That proved to be impractical, and the company shifted to culture in 300-acre ponds, which also failed. Another company established hatchery and grow-out facilities using waste heat from a nuclear power plant in order to overcome climatic limitations. This project failed when it became impossible to market the product because of tritium in the water source. A few years later another Florida project associated with a fossil fuel power plant began operation and made substantial progress in developing commercially viable controlled maturation systems. This group also began the first cultivation of *Paneus vannamei*, the Pacific white shrimp that now accounts for the bulk of the shrimp production in the western hemisphere.

In 1972 the University of Arizona in conjunction with the University of Sonora, Mexico began the development of a super-intensive grow-out system with the capability of producing up to 100,000 pounds per hectare per year. It was eventually shut down by viral diseases, but the University of Arizona continues today as a world leader in the area of shrimp health.

In the 1970's and early 1980's most U.S. shrimp expertise and investment capital went to Latin America and Southeast Asia as shrimp farming became successful in those areas. During this period the largest U.S. program was the U.S. Sea Grant-funded effort at Texas A&M. The State of South Carolina also made a large investment in shrimp research and development when it built the Waddell Mariculture Center in 1985. At about the same time the United States Department of Agriculture initiated a shrimp farming program that continues today.

Today there are U.S.-based shrimp farms in South Carolina, Florida, Texas and Hawaii, and strong research programs in those states as well as in Mississippi and Arizona.

## STATUS OF THE U.S. SHRIMP AQUACULTURE INDUSTRY

Although the U.S. shrimp aquaculture industry has a relatively long history, it is in many ways still a fledgling industry, and subject to growing pains. In 1996 there were approximately 30 private shrimp farms in the U.S., and they stocked 700 hectares of ponds and produced 1,300 metric tons of heads-on shrimp (Rosenberry, 1996). About 80% of the farms used semi-intensive rearing systems, and the remaining 20% used intensive systems. In addition there are at least 8 hatcheries in the U.S. producing shrimp post-larvae for sale or internal use.

The U.S. aquaculture industry for shrimp, accounts for only 0.2% of the world's supply of cultured product. Official statistics (NMFS, 1996) show that shrimp production from aquaculture peaked in the U.S. in 1993 when production reached 6.6 million pounds (3,000 metric tons) with a value of 26 million dollars, but has declined somewhat since then due to impacts by shrimp diseases. According to the last official aquaculture statistics in 1995 production was 2.2 million pounds (1,000 metric tons) with a value of 8.8 million dollars. Rosenberry (personal communication) estimated that in 1997 the U.S. had 8 shrimp hatcheries and 20 shrimp farms with a total of 400 hectares under production and a total yield of 1200 metric tons of heads-on product.

The largest sector of the U.S. shrimp industry is in Texas, and in recent years has accounted for about 70% of the national landings. In 1993 and 1994 Texas annually produced about 4 million pounds of cultured shrimp from 5 farms with more than 1400 acres under production. This crop had a pond-side value of approximately $11 million in each of those years. In 1995 and 1996 the Texas industry was severely impacted by the Taura virus, and landing fell drastically, to about 2 million pounds. Preliminary reports from 1997 indicate that the state-wide industry as a whole has improved somewhat, and produced about 2.6 million pounds from nine farms. Shrimp survival and therefore production was normal in 1997 from farms where ponds were dried following the 1996 season to control the Taura virus, but production was still virus-limited where this was not done (Treece, personal communication).

Texas also is the location of a "super-intensive" shrimp facility that is located 200 miles from the coast. This facility is designed to produce at a rate of 100,000 pounds per acre per year, but has so far not achieved this, and in 1996 reported some production difficulties.

In South Carolina there are currently 12 operating shrimp farms, and a total of about 250 acres of ponds are stocked annually. Farmed shrimp production in 1995 was about 1 million pounds, with a value of $3 million, but this was halved in 1996 due to disease problems with the Taura virus (Whetstone, personal communication).

Florida has a very small, and mostly experimental shrimp aquaculture industry (Berrigan, personal communication). The high value and general unavailability of coastal lands has led to the development of farms that operate in "hard" fresh water. Production figures are not available, but it is very small.

Hawaii has produced shrimp primarily for the local market for more than 12 years. In 1994 and 1995 production averaged only about 100,000 pounds per year, with a value of $500,000. In 1987, Hawaiian shrimp aquaculture had reached a production level of more than one million pounds, with a pond-side value of slightly less than $4 million.

There are about 8 shrimp hatcheries in the U.S. (Rosenberry, personal communication). The most significant hatchery production of post-larvae occurs in Florida and Texas, principally from three large commercial companies, and a few smaller ones. The largest hatcheries are not U.S. owned and the post-larvae are shipped to and used primarily in Latin American operations. These hatcheries employ about 125 people, and the value of the post-larvae produced exceeds $12 million annually (Berrigan and Lawrence, personal communication).

## SUSTAINABILITY ISSUES

The following topics follow the suggested discussion outline for the Consultation.

### 1. Estimate of the macro-economic benefits of shrimp culture.

The U.S. has no significant exports of shrimp produced from aquaculture. In 1996, U.S. exports of fresh, frozen and canned shrimp were 41 million pounds with a value of 157 million dollars (NMFS, 1997), and only a small portion was potentially from aquacultured shrimp. On the other hand, the U.S. incurred a negative trade balance in shrimp products in 1996 of $2.5 billion (NMFS, 1997), the largest deficit for any agricultural or fisheries product. If we use the estimate that half of U.S. shrimp imports are from aquacultured sources, then in 1996 the value of the imported farm-raised shrimp was about $1.25 billion.

Globally, the U.S. is important player in shrimp aquaculture and in shrimp markets and economics because it is the world's largest consumer of shrimp, and because it continues to provide substantial technological assistance to the rest of the world. The U.S. supplies shrimp farms in at least 50 countries around the world with a wide range of products and services, including research, production technology for both hatcheries and grow-out, equipment, larval shrimp for on-growth, broodstock, diagnostic and veterinarian services for disease control, pharmaceuticals for disease treatment, feeds, training and information. It is very roughly estimated from polling industry representatives that sales of these products and services to the international market amount to about 100 million $US/year as shown in Table 1. Some U.S.-based firms have also set up manufacturing and distribution companies in other countries to supply goods or services to the shrimp industry. This has happened with feeds, for example, where local manufacture avoids the high shipment costs of a bulky product.

**Table 1. The estimated value of exported products and services to the U.S. economy**

| Export Product/Service | Value $US |
|---|---|
| Consulting Services | 10,000,000 |
| Chemicals/Pharmaceuticals | 15,000,000 |
| Feeds (pellets and live foods) | 40,000,000 |
| Equipment | 20,000,000 |
| Live products (larvae/broodstock) | 15,000,000 |

## 2. Estimate of local benefits of shrimp culture.

The impact of the domestic shrimp aquaculture industry on the U.S. economy is considerably greater than the pond-side value of the product. The National Fisheries Institute (personal communication) estimates that there is $14 of economic activity, for every dollar of dockside production. Dicks et. al. (1996) in their survey of economy-wide impacts of U.S. aquaculture based on an agricultural model estimated that an industry economic multiplier of 3.5 which they feel may err on the conservative side. They found for most of the U.S. production of fish species that income in the production phase was only 8% of the total industry-wide revenue, and that 23% of the total economic activity generated was in the purchase of goods and services for production, and 69% was in goods and services added to the aquaculture outputs. Dicks et. al. (1996) also estimated job multipliers for aquaculture, and found that upstream inputs to production accounted for 22% of the jobs, production and processing only 9% and that 69% of all jobs created were in the distribution, retail and service sectors of the economy.

Using the 3.5 economic multiplier above, in the peak production year, 1987, the value of the U.S. shrimp aquaculture industry to the domestic economy was about $90 million, and the value in 1996 was about $28 million. The current total economic activity generated by the industry, even at the 1996 low level of production, is about $100 million - based on the NFI and Dicks et. al. (1996) multipliers.

In the U.S. the local impact of shrimp aquaculture has been small, largely due to the minuscule size of the industry. In some local communities with limited opportunities for employment, and in communities with chronic unemployment, the industry has provided some measure of economic revitalization.

Total direct employment in the U.S. commercial shrimp industry, including the hatchery segment, is only about 500 full-time persons. Overall about 1800 jobs are created by the industry, as estimated using the same overall industry multipliers.

## 3. Estimate of "domestic value added" return on investment.

There is no available accurate data on investment or profit levels on which to base estimates of aggregate return on investment from the U.S. shrimp aquaculture industry. The U.S. shrimp farming industry is fledgling and only occasionally profitable, and for the most part, private investment awaits the demonstration of more competitive production systems (Pruder, personal communication). It is estimated (Lawrence, personal communication) that U.S. shrimp farms can be very profitable in years without disease impacts.

## 4. Constraints to shrimp culture development and sustained production

There are a number of technical issues that constrain the U.S. cultured shrimp industry. The first is climatic - most of the U.S. is too cold to grow the important shrimp species. Even in the southern regions of the continental U.S. where temperatures allow cultivation, the growing seasons are restricted to the warmer months.

There is also an inadequate supply of shrimp larvae for pond stocking, especially high health stocks bred to minimize disease impacts. The recent increase in the number of recognized and significantly important diseases has complicated this process. Technology to protect shrimp stocks from disease agents is also lacking. The industry also believes that there are inadequate technologies available to satisfy increasingly restrictive environmental protection regulations.

In most parts of the U.S. where shrimp culture is feasible, development is also restricted by the unavailability or high cost of land. This is especially true in Hawaii, but applies to the other shrimp production states as well.

In addition to high land costs, there are high labor and feed costs that put the U.S. at a considerable disadvantage in global markets. The perceived high risks of shrimp culture also makes private capital accumulation for investment difficult.

On the institutional level, strict state and federal regulation regarding permitting for sites and for water use and discharge are often constraining to shrimp culture development. There are also regulations that deal with seed stock importation that limits industry development (Hopkins, personal communication).

### 5. Governmental and private industry measures to address problems and promote development.

The original development of shrimp aquaculture started first with university and government development of technology and demonstration projects, and was followed by private industry development. There is still relatively strong support of technology development by the Federal government and some state programs.

On the Federal level, there is government support for the development of "environmentally friendly" production technology, development of high-health brood stock and domesticated lines, pathology research and disease diagnostic techniques, and development of biosecurity protocols.

In Hawaii (Young, personal communication) the state government has assisted the industry through the establishment of aquaculture parks, by streamlining the permitting process, providing aquaculture veterinarian services, sourcing of initial disease/pathogen-free brood stocks, assisting with production problems via extension services, research and workshops, and marketing assistance.

A major technical problem in South Carolina is the unavailability of seed stock and there is some movement toward solving this problem by both state government and private industry. Most of the in-state hatchery production to date has been in government facilities. There is a government program to provide technical support for grow-out and hatchery development in South Carolina (Hopkins, personal communication).

The major current constraint to the U.S. shrimp aquaculture industry is the impact of diseases, especially from viruses. In 1996 Taura virus impacted 6 South Carolina shrimp farms, reducing production to about one-half of the 1995 levels. Diseased ponds were disinfected and limed after the 1996 virus outbreak. In 1997 fewer farms were affected by Taura virus, but an apparently indigenous form of white-spot virus did occur in some facilities and caused mortalities. In Texas disease caused a 90% reduction in production in 1995 and a 70% reduction in 1996 from the 1994 peak production year (Lawrence, personal communication). Similar events occurred in the same time frame in Hawaii.

An important evaluation of the potential impacts of shrimp viruses on cultured and wild shrimp populations was recently published (JSA Shrimp Virus Work Group, 1997). This study was sponsored by the Joint Subcommittee on Aquaculture, a group with representation from many U.S. Federal agencies. The publication is the first step in a process to assess the risks associated with shrimp viruses. The report summarizes the potential for exposure to viruses and the potential effects of such exposure, and concentrates mostly on wild shrimp populations but deals with virus risk to aquacultured populations as well. This group has had public hearings since the publication of the report, and will sponsor a peer review and workshop in January 1998 to define a qualitative risk assessment strategy.

The U.S. Marine Shrimp Farming Program( USMSFP), a Federally funded program that includes a network of allied institutions, funded primarily by the U.S. Department of Agriculture, was formed in 1984 to undertake research, development and transfer to the industry of technologies, products and services required for domestic shrimp farmers to become competitive in world markets. From the beginning it has recognized that to be competitive, U.S. producers must rely on advanced systems and technologies to offset cost advantages enjoyed by foreign producers. A major thrust of their funded research is in intensive, high technology shrimp production systems, with a goal to become a low-cost producer of wholesome seafood. These technology, shrimp stocks and feed development activities parallel the highly successful meat production systems in the U.S. The USMSFP also provides U.S. producers with direct access to reliable captive supplies of high health and genetically improved shrimp stocks and advanced disease diagnostic and treatment methods.

Within the USMSFP the Oceanic Institute has principal responsibility for genetic improvement of shrimp stocks including resistance to disease. Tufts University has the lead in quantitative genetics. The University of Arizona and the Gulf Coast

Research Laboratory are the principal disease research, diagnostic and treatment centers. The Waddell Mariculture Center and the Texas Agricultural Experiment Station are working on culture technology, including work on the impact of effluent on receiving waters. A new focus of the USMSFP is in the area of biosecurity, reducing risks to aquaculture associated with dependence on wild stock and addressing concerns over the introduction of disease and non-native species into the environment.

6. Rough quantitative estimate of the costs of shrimp culture not reflected in private cost calculations

There was a reasonable environmental regulatory framework in place in the U.S. regarding the placement of aquaculture facilities as the industry developed. This generally directed the siting of shrimp farms to less valuable land areas. In Texas, for example, shrimp farms have been built primarily on marginal lands that have been used for low density cattle ranching, but are too sandy or salty for profitable agriculture (Lawrence, personal communication).

The U.S. shrimp aquaculture industry has been severely impacted by diseases, especially most recently those caused by viruses. Lundin (1996) estimated that at least 4500 metric tons of potential production is lost annually due to diseases. This lost production would have a pond-side value of about $60 million. There is no evidence to date that wild stock shrimp populations are being adversely affected by viruses.

7. Estimate of the impact of the displacement of staple species and crops by shrimp culture

These impacts have been minimal, or non-existent, and there has been little or no impact on staple crops or crop prices.

8. Specific subsidies available to shrimp farmers

Except for government investment in shrimp research and development, which includes studies of waste-water treatment, there are no subsidies for shrimp farming in the U.S.

9. Important laws and regulations that apply to shrimp culture

The primary statutory authorities of the U.S. federal government relevant to shrimp aquaculture are:

The Fish and Wildlife Act of 1956 authorizes the Secretary of Commerce to conduct investigations and issue reports of the production and flow to market of fish and fishery products and to foster improvement of production and marketing practices in regard to commercial species of fish and shellfish, including those produced through aquaculture. This statute supports most of the research and data collection activities of NOAA's National Marine Fisheries Service.

The Coastal Zone Management Act of 1972 authorizes the Secretary of Commerce to approve and fund state coastal zone management programs that plan for, locate and regulate activities taking place within the coastal zones, including aquaculture facilities. Federal activities and Federally-licensed activities affecting the coastal zone must be consistent to the maximum extent practicable with state coastal zone programs that have been approved by the Secretary of Commerce through NOAA's Office of Ocean and Coastal Resource Management.

The Merchant Marine Act, 1936 authorizes the Secretary of Commerce, through NOAA's National Marine Fisheries Service, to issue loans for the acquisition, construction or reconstruction of qualified fisheries facilities, including both land and sea-based aquaculture facilities.

The Agricultural Marketing Act of 1946 authorizes the Secretary of Commerce, through NOAA's National Marine Fisheries Service, to provide seafood inspection services to the private sector on a fee-for-service basis. Many commercial aquaculture facilities use this NOAA program.

The Fish and Wildlife Coordination Act directs all Federal agencies to consult with NOAA's National Marine Fisheries Service with respect to Federal activities affecting fishery resources. NOAA uses this statute to ensure that regulatory activities of the U.S. Army Corps of Engineers, the Environmental Protection Agency, and other Federal agencies taking actions with respect to aquaculture facilities will not compromise the ability of marine and estuarine areas to provide sustainable yields of wild fishery resources.

The National Aquaculture Act of 1980 directs the Secretaries of Agriculture, Commerce and the Interior and other Federal agencies to coordinate Federal activities related to aquaculture and to prepare a national aquaculture plan. This statute also directed the establishment of the Joint Subcommittee on Aquaculture, an inter-agency body that develops national aquaculture policy.

The National Sea Grant College Program Act authorizes the Secretary of Commerce to issue grants to colleges and universities to fund research, education, training, and advisory services related to ocean, coastal and Great Lakes resources, including aquaculture. NOAA's Office of Oceanic and Atmospheric Research administers the Sea Grant Program.

The Clean Water Act gives the U.S. Environmental Protection Agency the authority to issue National Pollution Discharge Elimination Permits for discharges including those from aquaculture sources. For most of the states, the EPA has delegated authority for the permits to them. This act also gives the Army Corps of Engineers the authority to issues permits for the use of wetlands for aquaculture purposes.

Migratory Bird Treaty Act gives authority to the U.S. Fish and Wildlife Service regarding permits for killing protected bird species that are causing serious economic damage to agriculture, including aquaculture. Other migratory birds that might be shrimp predators are covered by the Animal Damage Control Act, administered by U.S.D.A.'s Animal and Plant Health Inspection Service.

Lacey Act gives responsibility to the U.S. Fish and Wildlife Service to enforce state laws prohibiting unwanted species introductions through interstate commerce.

Food, Drug and Cosmetic Act gives the Food and Drug Administration (FDA) statutory authority to protect the public health by regulating the use of drugs and chemicals used in aquaculture. It also is the basis for the food inspection program of the FDA, and the NMFS seafood inspection program that has additional product quality standards in addition to the safety standards.

Magnuson-Stevens Fishery Conservation and Management Act , as amended, defines fishing to include aquaculture and various aspects of the law apply to mariculture in the exclusive economic zone.

National Environmental Policies Act requires federal agencies to either certify a finding of no significant impact on the environment through an environmental assessment, or to prepare an environmental impact statement. For coastal shrimp farms these procedures are in place to allow federal authorities a mechanism to regulate permits for activities that might impact the environment, wild stocks or protected species.

Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 regulates the importation of non-native species into the U.S., including those to be used in aquaculture.
Saltonstall-Kennedy Act authorizes NMFS to make grants to private and public entities to further the interests of the fishing industry, including aquaculture.

The federal government has also begun implementation of the United Nations Food and Agriculture Organization's (FAO) Code of Conduct for Responsible Fisheries (Code), including Article 9 that deals with aquaculture development. In this regard, a part of the National Marine Fisheries Service's (NMFS) Implementation Plan for the Code (1997) includes marine aquaculture, and the NMFS Strategic Plan also contains similarly worded aquaculture elements. The NMFS Implementation Plan indicates support for the FAO Code and emphasizes scientific research, technology development, and a more efficient permitting process as key factors in promoting the development of robust and environmentally sound marine aquaculture.

On a state and local level there are regulations, licenses, and permits which apply to shrimp aquaculture relating to zoning, water use, environmental laws, health and safety issues, transport laws, exotic species introductions, wildlife management regulations and permit procedures and requirements ( Skladney and Bailey, 1995). Chief concerns, which vary a bit from state to state, are the use of exotic species, effluent discharge and the disease and genetic implications of the shrimp farm activities, especially as it relates to wildstocks.

As an example of more specific state requirements, in South Carolina the permits needed for shrimp farming include: (a) a general state aquaculture permit, (b) a state permit to import non-indigenous shrimp species for aquaculture which includes provisions to minimize the likelihood that imported seed stock will impact natural resources through disease or escapement, (c) state administration of the federal CZM program requires a permit to do construction in the coastal zone (generally limited to pumping stations and outfall structures), (d) state administration of the NPDES program requires a permit to discharge water, and (e) local business licenses and county construction permits may be required. Other important laws are (f) the provisions of the minimum wage and Fair Labor Standards Act and, of (g) the provisions of the state and federal tax code (Hopkins, personal communication).

### 10. The respective roles of local and national shrimp producers organizations, local and national NGO's, and local government in the planning and management of shrimp culture.

There are various U.S. groups, and U.S.-based groups that contribute to the planning and management of shrimp aquaculture in the U.S.

The Shrimp Council is a group made up of 25 U.S. companies, mostly processors and distributors, that formed in response to pressure from environmental groups. The goal of the Shrimp Council is "to increase shrimp and market growth in a manner consistent with good corporate citizenship", and their main concerns are in the areas of by-catch reduction in the shrimp fishery, in disease prevention for the benefit of both the wild fishery and shrimp aquaculture, and environmental issues such as habitat degradation by shrimp farms.

The Global Aquaculture Alliance was formed in 1997 to represent aquaculture, and especially the shrimp aquaculture industry, in the international arena in areas like trade, public relations and the environment. The Alliance intends to investigate and address the major environmental and production issues of shrimp culture, including mangrove loss and restoration, effluents and disease impacts and control and to publicize the positive aspects of shrimp culture. The Alliance has highlighted a campaign to institute a certification program for environmentally and socially responsible aquaculture based on the FAO Code of Conduct for Responsible Fisheries (Infofish, 1997).

Environmental non-governmental organizations (NGO's) have played a significant role in calling attention to the potential environmental problems associated with shrimp culture in the U.S. Their emphasis in the U.S. has been on shrimp farm pollution, transfer of diseases to adjacent wild stocks and the effects of escaped shrimp on the genetics of local shrimp. In most cases, the NGO's have made thorough investigations of the industry, and their discussions of the issues have been presented in a relatively balanced manner. On the whole the NGO's and the industry have similar goals regarding sustainable shrimp culture in the U.S. The differences most often involve the time scale necessary to achieve environmental goals, and the feasibility and present economic viability of new production technologies and strategies.

Within the States there are generally aquaculture advisory groups that advise on policy issues. Most state aquaculture or agriculture development programs plan and encourage aquaculture development within the States.

### 11. The role of integrated coastal management schemes.

In some states there are coastal management plans that include aquaculture development, but in most cases either technical, social or economic constraints have prevented the industry from utilizing potential areas (Hopkins, personal communication). In the U.S. there is often considerable local autonomy in deciding land-use or water-use issues relating to shrimp aquaculture. At times the use issue debate is masked by environmental issues, when the chief desire is to prevent development of coastal areas for other reasons.

### 12. Governmental institutions dealing with shrimp culture, budgets and activities.

Federal involvement in shrimp aquaculture is chiefly based in three organizations - the Department of Agriculture, the National Oceanic and Atmospheric Administration in the Department of Commerce, and the Fish and Wildlife Service, part of the Department of the Interior. Aquaculture-related work in these main agencies is supported by over 30 other federal agencies, and coordinated through the Joint Subcommittee on Aquaculture (JSA). The JSA operates under the National Science and Technology Council in the Office of the Science Advisor to the President. Total Federal expenditures for shrimp aquaculture are currently approximately $5 million per year, and the majority of that ($3.3 million) is Department of Agriculture support for the U.S. Marine Shrimp Farming Program. Pruder (personal communication) estimates that the U.S. has invested over $35 million over the past several years for research and development of technologies, products and services essential for profitable and sustainable shrimp farming.

On the state level, in the three principal states in which shrimp culture occurs, total annual expenditures are about $2 million (personal communications).

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# VIET NAM COUNTRY REPORT ON POLICIES FOR SUSTAINABLE SHRIMP CULTURE

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## 1. INTRODUCTION

### *1.1 Physical conditions*

The coastal plain of Vietnam covers an area of over 1.5 million hectare with a 3,260 km coastal line. All along the coastal line, there are many river mouths, lagoons and bays with abundant aquatic resources which constitute a variety of ecological conditions highly suitable for aquaculture development, particularly for various types of brackishwater and shrimp culture. The geographic, climatic and hydrological conditions (temperature, rainfall, tidal regime) are, in general, favourable for aquaculture activities and effective exploitation of aquatic products. In recent years shrimp production accounted for 30-40% of the total export turnover of aquatic products contributing large profits to the country and providing jobs and export markets.

### *1.2 Water body potential and present utilization*

Statistics indicate that Vietnam possesses about 1.4 million hectare of aquatic cultivable water bodies of which 548,000 ha (39%) are rice fields, 397,500 ha (28.4%) reservoirs, 290,000 ha (21%) tidal flats, 84,700 ha (6.1%) brackish lagoons, and 58,100 ha (4.2%) small lakes and ponds. Annual growth rate of all types of aquaculture is around 5%.

It is estimated that 590,000 ha of water surface were exploited for aquaculture activities in 1995. Of these, an estimated 250,000 ha (42%) are brackishwater ponds used for shrimp farming. The rest is used for different types of fish farming.

## 2. CURRENT SITUATION OF SHRIMP CULTURE IN VIETNAM

### *2.1 General development*

The culture of a variety of shrimp species takes place along the entire coast of Vietnam. Within the last two decades, shrimp culture has been developing at a very fast rate and become a key economic sector. In the beginning of the 1980s, the shrimp pond area was only 15,000 ha. It is now over 250,000 ha. The annual cultured shrimp production is about 75,000 tons, 50% of which are exported. There are significant regional differences in productivity and practices determined by climatic, hydrographic and geological conditions in the coastal zone of the country.

The area of shrimp ponds of the northern provinces including provinces of the Red River Delta and the northern central coast account for 11% of the total shrimp pond area of the country. Most areas in the region practice improved extensive shrimp culture with an average yield of 116 kg/ha and highest yields of 150 kg/ha. The shrimp yield of the northern central coast is higher with an average yield of 230 kg/ha and a maximum of 500 kg/ha.

Shrimp culture in the southern central coast developed very fast but due to topography, the available area for shrimp pond is limited and amounts to about 5% of the total of the country. The popular shrimp culture pattern applied in this region is the semi-intensive type. The average yield is very high at 729 kg/ha. The lowest yield is over 200 kg/ha. The provinces of Phu Yen and down south have an average shrimp yield of 600 kg/ha. Although, the area for shrimp culture is limited, the shrimp yield of Binh Thuan province is over 1,700 kg/ha.

The largest shrimp culture area belongs to the southern provinces within the north boundaries of Dong Nai and Ba Ria-Vung Tau. The Mekong Delta is the main and densest shrimp culture area of Vietnam. In 1994, the outbreak of shrimp diseases caused a huge loss for farmers in the region. The popular culture pattern applied is extensive and improved extensive. The average shrimp yield is over 200 kg/ha. Tra Vinh and Tien Giang provinces have cultured shrimp yields of over 400 kg/ha.

### *2.2 Culture systems*

There are three shrimp species that are commonly cultured in ponds and water bodies: *Penaeus merguinensis* (White shrimp), *P. indicus* (Indian white shrimp), *and P. monodon* (Black tiger shrimp). Currently, the main supply of shrimp seed for pond culture depends on natural shrimp capture in the secondary canals and on-farm drainage through bamboo weir traps. Production facilities for commercial shrimp seed production in hatcheries are limited.

#### 2.2.1 Extensive culture

Currently, extensive shrimp culture holds a very important role and share of the country's shrimp culture industry. According to 1994 statistics, extensive shrimp culture accounted for 78% of the cultured area. In general, average pond areas are 5-7 ha per farm which are larger than those in Ca Mau Bac Lieu and Ben Tre provinces (say over 20 ha/pond). Farmers depend completely on natural food propagation in the pond and on tidal water replenishment (e.g., slow-moving microscopic animals, algae, crabs, detritus). This system requires little money for the construction of ponds and gates, and operating costs are low. One or two crops per year can be grown.

In general, extensive shrimp pond farmers do not control the number of shrimp seed breeding in grow-out ponds. Post larvae shrimp from natural resources enter the ponds with tidal flushing and live there until harvesting. Predator populations are not controlled, ponds are not aerated, and little or no supplemental feed is provided. The stocking density is estimated to be from 0.5 to 1 seed/$m^2$ and the average yields range between 70-150 kg/ha/yr.

#### 2.2.2. Improved extensive culture

This pattern is called "improved" because of feed and shrimp seed inputs. The grow-out ponds are supplementary stocked with shrimp seeds to ensure the stocking density attains 1-2 seeds/$m^2$. Shrimp are fed with supplementary home-made feed made of chopped trash fishes, small shrimp, etc. The feed may be cooked or not. The average yield of this culture type is 200-300 kg/ha/crop.

#### 2.2.3 Semi-intensive culture

Semi-intensive grow-out ponds are generally smaller than extensive ponds: individual ponds are usually 0.5-2 ha in size. Pond sizes of 1-2 ha are easier to manage in terms of feeding and water management. A double gate system, one for water supply, the other for drainage are laid out in opposite corners of the pond.

Farmers generally maintain a higher stocking density (5-6 seeds/$m^2$) by supplementing natural production with some hatchery production. Besides natural food, shrimp are fed with farm-made mixed feed and pellet feed. Average yield is about 500 kg/ha/crop.

Recently, in order to get higher production, farmers have paid more attention to applying new technology in shrimp culture. This behaviour is the result of fishery extension activities widely developing in the Mekong Delta and in many parts of the country. However, this culture practice requires more investment, labour costs, management costs and others. The area where semi-intensive culture is practiced, is still moderate with just over 22% of the total.

#### 2.2.4 Intensive culture

Intensive shrimp culture is an industrial type of activity. It requires high investment for coastal infrastructure and high operating and equipment costs. Grow-out ponds should be aerated. High density of 30-40 seeds/$m^2$ is required. Shrimp are fed with pellet feed. Farm operation and management need to be run by skilled people.

Intensive shrimp culture is, up to now, applied only in a very limited area. Nam Hai and Hiep Thanh, the two private companies in Bac Lieu province are considered the best in terms of perfect investment in Vietnam. However, their production is not really stable.

### *2.3 Shrimp seed production*

The shrimp industry in Vietnam is strongly dependent on the supply of hatchery produced seed (post-larvae). Most shrimp hatcheries are located in the central provinces and in Khanh Hoa province in particular where more than 500 small and medium scale hatcheries operate mainly due to favourable climatic and hydrographic conditions that ensure a long season with high quality full strength sea water and temperature above 25°C. A large proportion of the production from these hatcheries (both nauplii and post-larvae) is sold to other coastal provinces especially in the Mekong Delta region.

A number of hatcheries also operate closer to or in the southern provinces where the production of shrimp is the highest and, therefore, where there is the greatest demand for shrimp post-larvae. However, due to the high variability in the water quality in this part of the country (e.g. the seasonal output of large volume of fresh water from the Mekong river) there are only a limited number of shrimp hatcheries compared to the central provinces.

Most of the hatcheries in the country are small and medium scale operations (5-15 million of PL) which, however, account for the majority of the post-larvae production in Vietnam. The hatcheries are normally privately owned and operated by 3-4 persons with usually the owner being skilled. There are only a few large sized state operated hatcheries, but these contribute little to overall production.

All hatcheries in Vietnam still entirely rely on wild broodstock. The central part of Vietnam is well known as a source of *P. monodon* spawners which are usually collected by the fishermen upon request from the hatcheries. The increasing demand for wild gravid females is placing a lot of pressure on the natural stocks and Vietnam will likely experience the same trend of over-fishing as has been experienced in other spawning grounds of South and south-east Asia. Indeed, the prices for gravid females have already increased considerably from around VND 100,000 in the late 1980s to the present level of one to several millions VND/head.

### *2.4 Contribution of shrimp culture to the national economy*

It is estimated that aquaculture contributes about 30% to total national aquatic production and an important share to the export value of the country, particularly, from shrimp culture. The value of shrimp products accounts for 30-40% of the total value of exported aquatic products.

Currently, the fisheries sector is developing as a high value agro-industrial economic activity in Vietnam, contributing greatly to the stability and development of the country (9% of the Gross Domestic Product). This growth has paved the way for planning the socio-economic development of fisheries until the year 2010, a stage for basic implementation of industrialization and modernization of fishery activities to become one of the key economic activities of Vietnam. Aquaculture is also a major contributor to local food supply (in 1994, Vietnam's annual fish utilization was an estimated 12.0 kg/capita).

At present, there are about 3 million people working in the fisheries sector of which, 300,000 work in aquaculture. The share of labour force in aquaculture is projected to grow from 10% to 30% of the total fisheries labour force. Up to the year 2010, total labour force in fisheries is projected to grow to 5 million persons of which 1,400,000 in aquaculture.

### *2.5 Difficulties encountered*

#### **2.5.1 General situation**

Although shrimp farming developed as an economic activity in the mid 1970's only in recent years it has become one of the most important aquaculture practices in terms of area under culture, production, employment and foreign exchange earnings. In 1994, over 250,000 ha of land had been converted into shrimp ponds with more than 50% in the provinces of Ca Mau peninsula, Ca Mau and Bac Lieu. In the last couple of years, however, the industry has faced a series of problems mainly due to the outbreak of diseases which hampered production outputs. Therefore, the economic risks increased as the area expanded. Lately, the storm Linda caused serious damage to shrimp culture in the southern provinces. It will take a couple of years to recover from this awful disaster.

Expectations of high profits in shrimp culture are luring a lot of people. They are rushing to invest in this field which is causing difficulties for the administration. Many socio-economic vices have appeared causing damages to mangrove forest and living environment. Actually, local governments could not control the activities in shrimp culture and almost all shrimp ponds belong to private people. Lack of knowledge in culturing techniques and spontaneous development are harmful factors for the environment. It contributed to the outbreak of shrimp diseases. In 1994, shrimp diseases caused a big loss for the economy.

### 2.5.2 Shrimp diseases

Shrimp culture in Vietnam has witnessed the same disease outbreaks as observed in other south-east Asian countries. After a number of years of shrimp culture operations, diseases broke out in the southern provinces. In early 1993 and reached full scale in late 1994. Research results showed that shrimp died with very clear disease symptoms. However, some shrimp died for unknown reasons. Surveys indicated that the main causes of shrimp diseases were related to shrimp seeds, environmental factors and farm management.

#### *2.5.2.1 Shrimp seed*

The major source of shrimp seed supply is from hatcheries in Nha Trang and some provinces of the south-central coast. Most nursing ponds in Khanh Hoa were infected with common diseases.

In 1992 – 1993, the demand of shrimp seed increased, therefore, many very young shrimp seeds (PL7 – PL8) were delivered to farmers. Test result showed that the rate of infection of shrimp seeds was very high. Those seeds were too weak when released into the pond environment. Consequently, they were very easily attacked by diseases.

#### *2.5.2.2 Environmental factors*

In 1993 and the first half of 1994, the climatic and hydrological conditions depicted unusual features: drought spells, high amplitude of day and night temperature, the water temperature in shallow ponds was very high at noon time, long inundation caused by rainfall and floods and, water supply source was unclean and full of sediments. As a result, the salinity at surveyed ponds was lower than the physiological requirements of shrimp. Moreover, dissolved oxygen was low, $H_2S$ and total iron contents were higher than their permissible levels, and, foul sludge accumulated on the pond bottom creating favourable conditions for the development of toxic algae.

#### *2.5.2.3 Management*

The amount of water in grow-out ponds was insufficient. The water depth was normally from 0.3 to 0.5 m. The sluices were installed unsuitably, and could not perform effectively the functions of water intake and discharge.

Saline water was taken directly from natural systems of canals by tidal movement to the ponds without settlement ponds. Therefore, water supply quality could not be controlled.

There were no separate systems of water supply and discharge. Many grow-out ponds used the joint water supply-drainage system. The water was then taken from pond to pond.
Farmers are not, in general, knowledgeable on shrimp culture techniques. They did not exert sufficient care of the pond environment when stocking seeds. Consequently, shrimp seeds got stressed and died very shortly after stocking.

Grow-out ponds were not well prepared. The density of wild shrimp population was unknown. After supplemental stocking, the density of shrimp increased causing stress for seeds.

The habit of using low quality feed, particularly fresh trash fish, is often a cause for low water quality in the pond environment. Undigested feed decomposes favouring the development of harmful bacteria and algae.

The practice of post-harvest sanitation is not taken seriously; as a result the grow-out ponds have a permanent layer of foul sludge of 20 –30 cm depth or more.

## 3. MEASURES TO RESOLVE PROBLEMS

### *3.1 Lessons learned*

Shrimp culture experiences similar difficulties as observed in animal husbandry or poultry farming. The disease risk increases when shrimp are stocked at high density in poor pond conditions. Experiences from high-tech countries in shrimp culture such as Japan, Taiwan (Province of China) and Thailand show that after a couple of years of success in shrimp culture, shrimp farmers faced similar difficulties caused by shrimp diseases.

Shrimp diseases and protection measures are the concerns of many shrimp producing countries, particularly, in the south-east Asian region. The most dangerous diseases are always caused by a multitude of factors. In general, the main causes of shrimp diseases include:

- unsuited environment,
- poor quality shrimp seed,
- ineffective management.

## *3.2 Measures taken*

### 3.2.1 Immediate measures

In its efforts for economic development, the Government has given a lot of attention to fisheries, in general, and to aquaculture in particular in order to increase yields, production and income, particularly in support of poor people in coastal areas to improve their living standards, eliminate hunger, alleviate poverty and overcome economic difficulties. Many sound polices were promulgated by the Government to develop aquaculture, and consequently, to protect the environment for sustainable shrimp culture and avoid side effects and negative impacts by aquaculture.

Over the last decade, Government promulgated many reform policies to open up and renew the economy. These encouraged and created good conditions for those who wanted to invest their money in shrimp farming at various scales. Regarding agriculture and aquaculture, the Government also promulgated many new polices in order to strengthen management measures and help farmers increase production. One example of this renewal has been the policy of giving land and forests to farmers for management and protection. This policy is very meaningful for the protection of mangrove forests along the coastal line.

Concurrently with allocating land and forests to farmers for better management and protection, the Government also promulgated the policies on rural and fishery extension activities in order to help farmers acquire knowledge in culturing techniques and aquaculture practices and in creating awareness of the need for environmental protection to realize better and stable living conditions. In helping farmers to avoid the harmful effects from unhealthy competition among shrimp seed dealers, the Government also promulgated very severe regulations on animal quarantines and formulated feeds. In addition, the Government also promulgated polices on preferential taxation of shrimp farmers. At the same time, many banks offered low interest loans in support of poor shrimp farmers.

A large number of 1-3 day training courses were held for shrimp farmers. In each training course, farmers were able to learn culturing techniques. Some experienced farmers were invited to present their experiences and know-how. In support of these extension activities, many demonstration sites were set up and concrete instruction manuals prepared. The results gained from the demonstration sites have proven more valuable than the lectures. Farmers always rely on what they really see. They will try to practice and will then show their results to others. Person-to-person communication is a very good and simple method that the Government has already applied successfully in other fields.

Besides the management measurements, Central and Local Governments invested into improved infrastructure facilities, such as roads, and main water supply and drainage systems in order to support shrimp production. Furthermore, many shrimp processing plants were built to international standards; this helped farmers to find a ready outlet for their shrimp production, thus avoiding exploitation from middlemen.

The Central Government also assigned the task to the Ministry of Fisheries in cooperation with other agencies for developing an aquaculture master plan with the following objectives:

- Proper utilization of aquaculture potential;
- Quick development of processing industry aquaculture output;
- Support of infrastructure construction for aquaculture.

### 3.2.2 Long term measures

The lessons learned from the study on "Causes for mortality of cultured shrimp and protection measures" have shown that in order to sustain the production of cultured shrimp it is necessary to take simultaneously measures to solve all issues related to shrimp seeds, environment protection, farm management and technical aspects. In all cases, human resources development should be given top priority. In order to exploit and develop the natural resources in a sustainable way, we need to know very well the objectives we are aiming at, the ecological changes generated from our activities, precautionary measures and methods for sustainable development. Those requirements can be satisfied through proper polices for rural extension, education strategy, and investment and credit support system.

#### a. Fishery extension

During the last three years, especially after the government's promulgation of Decision No. 13/CP specifying the fishery extension activities aiming at the development of high and sustainable culture of aquatic products, the fishery extension networks have expanded greatly at the district level. The officials in charge of the agriculture and fishery extension services have contacted farmers to guide them in cultivation measures.

The number of professional fishery extension officials specializing in aquaculture is however still limited. Usually, the agriculture officials are in charge of extension services. The region under their responsibility is great and the transportation conditions are difficult. The receipt and exchange of information is restricted.

In order to increase fishery extension activities, the assistance from the Central Government and local authorities is therefore badly needed. It is advisable to expand the fishery extension networks down to the village level and increase the number of fishery extension officers. The capacity of the cadres can be upgraded through effective communication methods.

It is necessary to expand the fishery extension services aiming at well-managed shrimp farming and acting as early warning system of possible risks of epidemic disease outbreaks.

There will be no sustainable shrimp culture without close cooperation by farmers, input supplies and others. Therefore, education and awareness creation is crucial to enhance cooperation and achieve effective environmental protection.

The relationship between fishery extension staff and local mass organizations such as the Youth League, Women's Association, and Farmers' Association should be improved. These organizations will be the key forces for awareness creation and education which are indispensable to achieve sustainability.

#### b. Training and education

It is advisable to organize on a continuous basis training courses with updated knowledge on aquaculture and provide everybody the opportunity to participate. The curricula should be prepared carefully to be appropriate for every participant.

It is also wise to create favourable conditions so that women and youth can participate in these training courses. In fact in rural areas, women and youth are those who are directly involved in taking care of aquaculture activities. Regarding them, their daily works do not allow them to live far away from their families for long time periods. Therefore, one-day short training courses may be most appropriate for them.

The fishery extension cadres should be continuously trained and their knowledge updated through local level training courses or courses at scientific research institutes and universities. Study tours within the country and abroad should be frequently organized for these staff.

The Fisheries Ministry should cooperate with the Ministry of Education and Training to set up a training strategy related to aquaculture and environment protection. Training course should follow the most appropriate schedule and curricula to attract participation of all interested persons including secondary students, fishery extension cadres, technical staff and research cadres.

### c. Research

Applied research undertaken with the participation of several scientific research agencies and universities has proven always highly effective. The experience of the Research Institute for Aquaculture II is an example. After having been assigned by the Fisheries Ministry to undertake the study project: "Causes for mortality of cultured shrimp and protection measures", the Institute has closely collaborated with fishery research agencies and universities. As a result, within a short time period, the research was successful and highly appreciated. The research results enabled people to understand the general management requirements of aquaculture.

However, scientific research projects should not be limited to address one time measures. In order to obtain widely applicable findings, research on the sustainable development of shrimp culture should be implemented in all typical ecological regions on a long-term basis.

It is necessary to intensify research in the following fields: evaluation of environmental impacts, diseases, carrying capacity of ecosystems, and technical measures aiming at highlighting the effectiveness of management and good farm practices under various ecological settings.

### d. Investment

So far, most investments into coastal shrimp culture were undertaken by the private sector. Within their limited capacities, shrimp farmers are capable to maintain production activities with a minimum of investment. However, investments are too limited, often uncoordinated and not in compliance with the master plans, which create not only waste in terms of money but also environmental risks. The shrimp epidemic outbreaks are examples.

The Central Government and local authorities should establish development strategies, zoning, and planning in accordance with the ecological conditions of each region. The development strategies and plans should be communicated to the people and communities. The clear assignment of responsibilities to communities will enable them to know precisely their roles and responsibilities in co-management to attain an efficient utilization and protection of the natural environment in accordance with the concept of sustainable development.

In recent years, the Government is most interested in infrastructure investment to assist in production development. With regard to aquaculture, the Government has promulgated a programme for the exploration and utilization of fallow land, riverine and coastal zone, and other water bodies whose target is infrastructure construction and development in support of aquaculture activities. This programmes has provided funds from the national budget for the construction of roads, dykes, main water supply canals and drainage in regions where shrimp farms concentrate. Many projects have been implemented under this programme.

### e. The rural credit system

Financial services in the rural areas of Vietnam are delivered through the formal and informal sectors. The formal sector comprises the state bank system. However, two-thirds of loans in rural areas are provided by the informal sector comprising relatives, professional lenders, businessmen etc. This is the most important source of capital which is rather flexible, and provides loans in a simple and fast manner and appropriate for common people. However, in some places, the interest rates of this sector are not always suitable for the scale of production and large investment requirements..

The state credit system through banks - due to their structure and control - require mortgages and complicated procedures that are not suitable for small-scale investors. In order to assist in their production activities and make effective use of loans the state banking sector has to study their specific credit requirements.

In order to assist the above activities, the Government has promulgated regulations on loan policy, which spell out scope and conditions, sources, forms and interest rates of loans. The Government has also highlighted appropriate improvement measures to upgrade the effectiveness of banks and simplify their procedures. Concurrently, the Government has set up assistance funds for production and poverty relief, especially special banking systems for the poor aiming at providing funds for their production activities.

### f. Processing

The Government encourages the development of an effective shrimp processing system, not only in order to create added value export products but also to expand outlets for shrimp producers. Processing plants are required to form a contingent of efficient purchasing staff, who can help the farmers to sell their products, thereby restricting fraudulent market practices and also to limit the scope of businessmen who wish to create pressure on sales prices.

### g. Feed catering services

Unable to use costly high quality industrial feed, shrimp farmers generally rely on the use of various small fish of poor quality or industrial by-products as the main sources of feed. However, even these feed supplies are not always available in sufficient quantity. Moreover, the use of poor quality feed is a major cause of pollution of the pond water environment.

In addition to good quality feed for shrimp culture imported from the CP Group, there are also local feed processing plants. Studies indicate that locally produced pellet feed is sold mostly in the provinces of central Vietnam while little is sold in the Mekong delta and the Northern plains. This might explain why the yields of shrimp farms in Central Vietnam are higher than other areas which predominantly rely on non-pellet feed.

High prices of pellet feed are, however, the main obstacles to the farmers' choice of this kind of feed despite their knowledge that the use of pellet feed increases yields and avoids pollution of the pond environment.

## 4. SUSTAINABLE DEVELOPMENT OF SHRIMP CULTURE

### *4.1 Promulgated policies*

### 4.1.1. Environment

- Mangrove forests: logging stop and reforestation of coastal areas to restore the mangrove vegetation.. Newly planted forests should be thinned in accordance with recommended regulations.

- Agriculture: Integrated Pest Management (IPM) measures limit the use of insecticides to prevent residue flushing into the coastal areas affecting extensive and improved extensive shrimp farming releying on tidal action.

- Quality of water: The Government has publicized a number of water quality criteria applicable to the environment in general and aquaculture specifically.

- Resource management: restriction on the use of fishing nets with small mesh sizes.

### 4.1. 2. Economic - social - political policies

- The Government issued decrees on the allocation of lands, forests and, inter alia, water bodies for aquaculture for the people's long-term use.

- Some important policies: 327/CP Programme on the reclamation of fallow land to reforest bare hills and 773/CP Programme aiming at using fallow lands, wetlands and coastal areas. With these policies, the Government is aiming at supporting, inter alia, aquaculture farmers through infrastructures construction such as main canal system for water supply and drainage, according to the local master plan. Based on such plans the allocation of land to farmers with an area of 1 to 5 ha/per family is done.

- Taxation on the use of the water bodies: mainly in accordance with the agricultural tax applied to fallow land exploration (first 3 year are tax exempted), the use of water bodies for long-term aquaculture is taxed (e.g. 280 kg of rice/ha/year (1 kg of rice = 1,700 VND)).

There is no taxation policy exclusively for aquaculture and there is no price subsidy for shrimp culture. Shrimp farmers have to sell their output and buy feed, equipment, and other inputs at market prices.

Through associations like those of farmers, veterans, women or the Village People's Committee the Government should be requested to issue policy to enable the Agricultural Bank to grant low-interest rate loans to shrimp farmers.

A proposal is under consideration to establish a specialized bank to grant loans to poor people for economic activities including shrimp culture farmers. The loan period is always short depending on the harvest. Therefore, regarding shrimp culture, if the harvest is good, the farmers are able to repay, and otherwise repayment will be difficult. The risk in shrimp culture is higher than in rice cultivation.

### *4.2 Institutional system*

- Provincial Departments of Fishery (PDF) were established in the coastal provinces of Vietnam. The Sub-Department of Fishery Resources Protection is a unit belonging to PDF with responsibility for fishery resources protection and quarantine.

- Fishery Extension Centers were established to assist PDF in aquaculture technology dissemination.

- Fishery Sections were established in the districts to assist PDF and District People's Committee in matters related to fisheries management.

- The three above institutions assist the Provincial People's Committee (PPC) in fisheries management. Fishery Development Plan is formulated by the planning section of PDF for submission to the PPC and the Ministry of Fishery (MOF).

- The Department of Science and Technology (DST) of the MOF has responsibility in scientific and technical management, research and development of new technologies for effective application in each different ecological zone of Vietnam.

- Besides the DST, the MOF comprises a Fisheries Management Department (which is responsible for fishery extension activities in the whole country), and Research Institutes and Research Centers responsible for the study of, for example, technologies of shrimp culture, seed production, feeding and disease.

- The fishery research institutions include :

    * Research Institute of Marine Products (Hai Phong);
    * Research Institute for Aquaculture No. 1 (Bac Ninh);
    * Research Center of Fishery No. 3 (Nha Trang); and
    * Research Institute for Aquaculture No. 2 (HCMC)

- MOF is also in charge of the Technical School and Professional School to educate technicians and technical workers of fisheries.

- In addition, academic fisheries institutions come under the Ministry of Education and Training, such as :

    * University of Fishery of Nha Trang;
    * Faculty of Fisheries of Agriculture and Forestry University of HCMC; and
    * Faculty of Fisheries of Can Tho University.

Thus the research and education system for fisheries and aquaculture including shrimp culture is quite powerful.

Modernization of equipment and improved research competence are very important requirements to contribute to the strategy on sustainable development of aquaculture.

### *4.3 Measure to promote sustainable development of shrimp culture*

Shrimp culture is a very important activity for economic growth of the country over the coming years and in the long term. Sustainable development of shrimp culture is a priority target of the fishery development strategy in general and of aquaculture in particular.

Some immediate and long term measures for sustainable development of shrimp culture are as follows :

### 4.3.1 Immediate measures

a. Measures with regard to seed production

- Strengthening and enhancing the quality of activities related to quarantine, seed control, service system, and insurance of aquaculture; promotion of seed quality management of hatcheries and nurseries.

- Strict implementation of MOF regulations on quality standards of hatcheries and nurseries and adding some other needed regulations for each of them.

- Checking on quality standards of existing hatcheries and stopping the production of low quality hatcheries. Planning and reorganizing sound system of hatcheries and nurseries to ensure high seed quality and to fully meet the seed demand of shrimp farms.

- In some places where seed is needed but production impossible, the import of PL could be carried out to acquire the seed (2-3 cm) for local shrimp culture, but quarantine has to be done carefully and adopted to local conditions.

b. Technical measures

- Apply new technology to avoid pollution of the pond environment.

- In the places, where shrimp culture has not been successful, research is needed to develop and adopt improved methods.

- Shrimp culture should only be done in suitable locations.

- Diversify the cultured species with the suitable culture models to be effective in land use and avoidance of diseases.

- Strict application of pond management with following key technical measures :

    - Careful preparation of pond bottom and treatment with lime and chlorine.

    - Careful management of pond water

    - Pond water needs to be taken from suitable settlement ponds.

    - Seed quality needs to be carefully controlled.

    - Pellet feed must be used; if that is impossible, fresh feed and poor quality fish need to be cooked well and fed in suitable quantities to avoid water pollution.

c. Extension and regulatory measures

- Promote and expand fishery extension activities through, inter alia, establishment of many demonstration model farms which are suitable for local conditions.

- The expansion of shrimp culture in over-used areas needs to be prevented by the local government, especially the cutting od the forest for shrimp culture.

- Promote mangrove forest protection activities and combine land allocation for aquaculture with reforestation to attain a sound ratio between forest area and water surface area.

- Step by step setting up of team work and cooperation through groups and associations of shrimp farmers.

### 4.3.2 Long term measures

1. Local and Central Governments should develop properly the investment planning for the aquaculture sector, particularly for the focal zones of shrimp culture, determine the right balance between the extensive, improved extensive and semi-intensive culture, and encourage to apply semi-intensive culture for the effective utilization of brackish water bodies.

    - Develop infrastructure planning of water supply and drainage systems for aquaculture
    - Promote coastal zone planning for aquaculture
    - Standardize shrimp hatcheries
    - Develop the quarantine systems at central levels and down to local levels.

2. Establish close cooperation between concerned institutions such as Forestry (rehabilitation and development of mangrove forests), Water Resources (develop water supply and drainage systems), and Agriculture (promote the practice of IPM). Seek to it that environment protection agencies take serious measures to prevent the discharge of industrial toxic wastes into water bodies.

3. Invest into integrated scientific research for environmental management and aquatic animal health care at national level (particularly for shrimp) in order to build up the scientific basis and conditions for solving all technical matters of diagnosis, protection and treatment measures and epidemiology in shrimp culture.

4. Develop a national network for monitoring the aquatic environment (and separately for shrimp culture) in order to set up the basics for development planning and forecasting the changes of the aquaculture environment that will help farmers to deal with diseases and take proper treatment measures.

5. Development planning for the reforestation of mangrove forest to ensure ecological balance and create a natural filter and a safe area inside the forest and to prevent erosion of coastal line.

6. Government should promulgate proper policies on taxation and credit in order to promote sustainable and stable shrimp culture including a price support policy to protect farmers' interests when there are high price fluctuations on the world's markets; make available disaster support funds to farmers when faced with sudden disasters and outbreaks of diseases.

7. Association of farmers, aquaculturist and other social associations, such as of women and youth should develop the sense of community and increase awareness about the need for cooperation and compliance with regulations on quarantine, environmental protection and aquaculture safety.

## MALAYSIA REPORT

# SAMAK AQUACULTURE: TOWARDS SUSTAINABLE AQUACULTURE

by

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## A. INTRODUCTION

The most widely quoted FAO definition of sustainable development states that :

> *"Sustainable development is the management and conservation of the natural resources base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry and fisheries sector conserves land, water, plant and animal genetic resources) is environmentally non-degrading, technically appropriate, economically viable and socially acceptable".*

Guided by this definition, this article will be focusing on the approach adopted by Samak Aquaculture (SAMAK) in its efforts to achieve a sustainable development in shrimp farming from the early stages of the Project until now and its future plans.

## B. CONCEPT

To achieve a sustainable production, many design elements and technical aspects have to be considered before and during construction of the Project. The design together with responsible management policies and practices adopted are aimed at an environment-friendly aquaculture practice.

A comprehensive feasibility study conducted in early 1991 indicated that ventures into modern shrimp farming are highly economically viable provided that its sustainability is maintained. For efficient use of resources, the Project has to achieve its economies of scale by embarking on a large scale where all the sustainable elements can be included.

The study also suggested the following considerations as the catalysts for the sustainable development :

### 1. Site Selection

The soil, water quality, infrastructure, climate and the human resources market available has to reach a certain minimum criteria to minimise the environmental impact.

### 2. Design Criteria

Certain parameters have to be considered to ensure a facility which can promote efficient resource with minimal environmental effect.

### 3. Management Policies and Practices

Proper management policies and practices of the farm is vital, if not the most important factor, in moving towards a sustainable development.

Taking all these factors into consideration, the study suggested that South East Asia is the most suitable region for shrimp farming zeroing into Malaysia as the most suitable county given its encouraging government incentives and stable political climate. Narrowing further, the State of Kedah in Malaysia was chosen as a suitable state mostly for its less industrious activities. Besides satisfying the abovementioned criteria, the selection of Air Hitam site for its many logistical advantages including:

- large uninterrupted **non-mangrove** land area with few houses and tall vegetation The Project site is located on a piece of padi fields land with flat topography and very few vegetation and houses. No original flora and fauna other than that naturally occurring in irrigated padi fields has been disturbed.

- located in one of the lowest agricultural income groups in the country.

## B. DESIGN

To achieve a sustainable production, many design elements and technical considerations have to be taken into consideration before and during construction of the Project. The design together with management policies and practices adopted are aimed at an environment-friendly aquaculture practise. However, it should be mentioned here that, contrary to what have been said in theory, from SAMAK's own experience it was found that to include the sustainable elements into the Project involves a large capital outlay.

If aquaculture facilities are properly designed, operated, managed and monitored, then the adverse effects on the environment can be minimised. Instead, it will lead to a considerable economic benefits.

With that in mind, a preliminary coastal aquaculture management and development plan for the area between Kuala Sanglang and Kuala Kedah was prepared as a first step towards achieving a sustainable aquaculture.

Despite the fact that an Environment Impact Assessment (EIA) is not a required by the Malaysian law since the Project is not located on a mangrove land, SAMAK had, at two different stages, prepared preliminary EIA. SAMAK is of the view that an EIA for the whole area, instead of the Project in isolation, is necessary as the impact of the other aquaculture practitioners' action will affect the other. It needs to be reiterated that the drive towards sustainable aquaculture can only be successful if the whole industry work together and combine their efforts towards achieving this objective.

To summarise, the main elements of the project are as follows :

| Package No. | Description |
|---|---|
| **PHASE 1A** | |
| Package 1 | 126 one-hectare ponds, a sedimentation basin and associated structures |
| Package 2 | 2.060 km water intake jetty and flume structures |
| Package 3 | Supply and Installation of Electrical System |
| Package 4 | General Buildings and Administration Complex |
| Package 9 | Hatchery |
| Package 10 | Fencing Works |
| **PHASE 1B** | |
| 1 | 100 1-hectare ponds and its associated structures similar to Phase 1A |
| 2 | two reservoirs with five inlet structures, a pumping station and an additional substation |
| 3 | fencing works |

## C. MANAGEMENT

Achieving the objectives of sustainable aquaculture requires enormous efforts. Striking a balance between the competing needs and objectives various parties involved requires an efficient and ecologically sound management systems and techniques, based on all available knowledge and experience.

In SAMAK, various management measures are introduced to ensure that the shrimps are produced in profitable and sustainable systems. Soil, water, feed and PL and human resources management are the most important elements in shrimp culture production. However, these factors are to some extent interdependent and the farm should be managed by taking all this factors into consideration, instead of managing one in isolation.

### Technical Know-How

The technical team has been assembled to build on the best available experience from other countries to meet the corporate objective of demonstrating environmentally responsible, commercial shrimp farming. It includes full time and consulting staff with the dual responsibility of establishing successful operations and training of local staff in shrimp farm operation. The full time technical team has over 140 man-years of experience in commercial shrimp farming operations and draws from a wide range of nationalities, Thai, Filipino, British, Taiwan (Province of China), Indian and Malaysian. In addition to the full time technical staff, SAMAK also calls on the services of outside experts from their extensive contacts to advise on various issues.

SAMAK is also keen to promote improved understanding of the factors involved in sustainable shrimp farming by working with other groups to further develop the technology of shrimp farming in ways which are compatible with environmental and social demands. Links with universities and government agencies within and outside Malaysia are being strengthened to make the project a truly collaborative effort and a model for further development.

### Health Management

Where possible, the Company adopts an all-in-all-out farm management technique to control the spread of disease and to maximise efficiency. Additionally, it is the Company's policy that PLs procured from the local hatcheries are healthy PLs and they are tested for any presence of specific pathogen before stocked into the ponds. Test on presence of specific pathogen is carried out at various stages - purchase of brood stock, release of PLs from hatchery and scheduled tests once PLs are stocked into the ponds. Moderate stocking density is adopted to ensure that at any point in time the condition of the pond bottom is not stressed and to ensure sufficient supply of dissolved oxygen in the pond, a combination of paddle - wheels and water jets totaling 14HP are installed in each pond. To avoid contamination by contact, sharing of equipments between ponds are strictly prohibited.

### Water Management

This farm does not use any fresh water. Instead, the water pumped from the sea is settled and treated in two reservoirs before they are being pumped into the ponds. Screening at six separate locations along the water flow path is introduced to ensure that the water that goes into the ponds is free from any possible carriers of disease. Subsequently, the water is tested for any presence of pathogen. These measures are taken to minimise the risk of introducing disease carriers into the system. In the sedimentation basins, mussels and seaweeds are to be introduced as bio-filters.

### Human Resources Management

Each sector consisting of 24 to 26 ponds is led by one Sector Manager incharge of the personnel and administration issues and a Farm Technician to be responsible for the technical matters involved. They are supported by two Farm Supervisors in charge of one row each and assisted by 8 Pond Operators each.

In striving to achieve an efficient and effective communication system and flow of information, various Committees with different objectives at different levels are introduced. The committees include Farm Technical Committee ( to discuss and plan on technical matters), Farm Management Committee (to plan and discuss on administration, human resources, security and farm management matters), Sector and Row Committees to provide inputs and feedback to the two earlier committees .

Staff, from Pond Operators to Farm Technicians, are sent for training locally and abroad to keep them updated with the latest technology and practices in the industry, to acquire more knowledge about shrimp farming and to pass on the knowledge to their subordinates and co-workers.

### Information Management

Besides these, the Company has also secured a Farm Management computer software in assisting the management to monitor and control the progress of the farm and to provide reports for the Management to make informed decision on the operations.

In keeping the links with the rest of the industry world wide and getting the latest information and technical know-how on the industry, the Company has registered as a member of various international and local associations and bodies, houses of experience and learning institutions related to aquaculture.

Sustainability in shrimp farming involves a chain of inter-related elements and players starting from production of PLs, manufacturing of feed, the culturing of shrimps , to processing and marketing of shrimp products. We endeavour to do what is best for the industry on our part. However, unless and until all the players involved in the shrimp industry play their part well, it will be a long time before the industry can compare with the level of sustainability achieved by the salmon rearing industry in Norway.

## D. CONCLUSION

To ensure that the concept of sustainable aquaculture is implemented in the Project, SAMAK strive to produce better overall biotechnical performance of crop, more efficient feed management by reducing the FCR, introduce specific pathogen free brood stock and high health PLs. In respect of the last item, SAMAK together with some other big producers in Thailand, are involved in a research programme to produce SPF P.monodon for commercial shrimp farming in Thailand.

As well as urgent need for the practices adopted by shrimp farmers to be governed by a set of guidelines and procedures, the enforcement of these guidelines and policies should also be diligently implemented. In addition, the awareness should also be created among the practitioners of the industry on the importance of adopting sustainable methods of farming.

Again, successful drive towards sustainability in shrimp farming requires concerted efforts by all parties involved.

# WORLD BANK GROUP ASSISTANCE FOR SUSTAINABLE SHRIMP CULTURE

**comments by**

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1. On the occasion of this Consultation, I want to express my appreciation to the FAO for the invitation to participate in and for its organizing this important forum, which has brought together representatives from government, bilateral, multilateral, NGO, and private sector organizations. I believe this meeting is an important step toward achieving strategies and models of sustainable shrimp culture that are socially and environmentally acceptable.

## Bank Group Assistance

2. The Bank Group, which includes the International Development Association (IDA), International Bank for Reconstruction and Development (IBRD) and the International Finance Corporation (IFC), has provided assistance for sustainable shrimp culture development through: (a) formulation and investment financing of development projects which include shrimp culture via specific requests from its member governments; (b) commissioning a 1997 study on shrimp farming and the environment; and (c) initiating in December 1997 a Marine Market Transformation Initiative with the Royal Government of Thailand for the formulation of a "Code of Conduct for Shrimp Farm Operations." The objectives of The Bank Group's involvement in shrimp culture is to assist its clients in their efforts to establish sustainable shrimp culture for the purpose of alleviating coastal poverty and generating employment and foreign exchange earnings.

## Project Experience

3. Up to the present, the Bank has provided direct assistance since 1984 for a total investment of about US$450 million to 14 projects which include shrimp culture components of which nine are complete. Twelve of these projects were or are being implemented in the Asia region with one each in the Africa and Latin America regions. Currently, Bank assistance has been requested in the formulation of five additional proposed projects which include shrimp culture components. Many of the completed and ongoing investment projects have suffered from shrimp disease pandemics which further endorses the importance of improving sustainability by reducing risks to the financial viability, environment, and social conditions in the project areas.

4. All Bank-assisted shrimp culture developments employed what was at the time or is presently considered state-of-the-art technologies, though over the past decade and a half, the concepts for sustainable shrimp culture have changed considerably and these changes were included in the design when the project was under consideration. Recent evaluations of proposed shrimp farm development by The Bank Group have taken a much more cautionary approach, in light of recent experience, which considers investment support for pilot and/or shrimp farm rehabilitation components that employ promising technologies. In addition, the current knowledge about potential adverse environmental and social impacts have been incorporated in project formulation with prevention or mitigation measures included as a result of detailed environmental and social assessments. Current projects often include the formulation or consideration of coastal zone management plans for site selection which not only protect critical natural habitats but also help assure good source water quality for the planned component. Project preparation also involves participation and consultation among all interest groups including the receiving community and potential beneficiaries.

## Shrimp Farming Study

5. By 1997, questions and concerns over adverse environmental and social impacts of shrimp farm development and its suitability for development in coastal areas were receiving increased attention. To address these concerns in light of the continued interest among several of the Bank Group's member countries for shrimp farm development assistance, the Bank commissioned a study on shrimp farming and the environment based on published information with specific emphasis on analyzing its suitability as a technology for sustainable employment generation and poverty alleviation in poor coastal communities. These communities are often highly dependent upon common property fisheries resources for their livelihoods that has led in many cases to over-exploitation of those resources. In addition to local financial and economic importance, shrimp culture can also have national significance as a foreign exchange earner. The consultant's final draft report was completed at the end of 1997 and has been sent for peer review. This work was designed as the first of a potentially two-phased initiative with the second phase involving more direct field assessments in the major shrimp farming regions of the world. The draft Terms of Reference for the second phase include: (a) further assessments of sustainable practice; (b) existing legislation and experience with regulations and enforcement procedures; (c) tax incentives for sustainable shrimp culture; (d) social and environmental impacts; (e) potential for employment generation; and (f) descriptions of specific case studies of the range of practices. The peer reviewers' comments on the importance of the follow-up work would be considered in determining whether to proceed with the second phase.

## Marine Market Transformation Initiative (MMTI)

6. In December 1997, the Bank initiated a MMTI with the Royal Government of Thailand with the objective of formulating a Code of Conduct for Shrimp Farm Operation. The first phase of this work is: (a) to develop relationships between exporters and importers and (b) to prepare and disseminate information packages on cost-effective technologies for sustainable shrimp farming. The second phase of the MMTI would be to assist in the creation of an enabling environment for the shrimp industry to comply with and benefit from sustainable, environmentally sound, and socially acceptable shrimp farming methods.

7. In closing, I want to affirm that I find this FAO Consultation, FAO's continuing efforts in support of sustainable shrimp culture development, and the related activities of other agencies in the process all to be of benefit to The Bank Group's on-going assistance to its clients. This work is of particular importance to governments' interests in establishing sustainable shrimp culture for the purpose of alleviating coastal poverty and generating employment and foreign exchange earnings.

# BENEFITS OF SUSTAINABLE SHRIMP CULTURE

by

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## INTRODUCTION

There has been increasing publicity recently over the environmental and social issues related to shrimp farming. Concern has been expressed over the adverse environmental impacts of shrimp aquaculture (eg loss of mangroves, loss or degradation of agricultural land, coastal pollution, etc) caused by some improperly designed and poorly managed shrimp farming projects. This has prompted calls for shrimp farming to be carried out in a more environmentally friendly and sustainable manner.

There are many examples of sustainable shrimp farming operations in existence. The activities of such well designed and properly managed farms have shown that, when shrimp farming is carried out in a sustainable and environmentally friendly manner, adverse impacts on the environment and surrounding communities can be minimised or avoided altogether. On top of that, shrimp farming brings many benefits, not just to the local communities located around shrimp farms but also at the national level to the countries in which the shrimp farms are based.

This paper looks at some of the benefits resulting from sustainable shrimp culture activities. Attempts have been made to collect, as far as possible, quantitative data from published sources; however, it has been difficult to obtain hard figures in relation to certain aspects. It is felt that much more information will surface during this workshop, especially from the individual country papers, which will help to further substantiate the issues discussed in this paper.

## ECONOMIC IMPORTANCE

Shrimp farming generates considerable economic returns and, on an annual basis, earns around US$6 billion at farm gate prices with the figure probably double this value as shrimp moves up the market chain to the consumer. Recent estimates suggest that the industry is worth US$20 billion in Asia, with infrastructure investment in ponds alone worth around US$11.5 billion (ADB/NACA, 1997).

## EXPORT EARNINGS

One of the most important benefits of sustainable shrimp farming is in the foreign exchange earnings which it earns for the producing countries, thus helping to improve the balance of trade. The revenue is of significant importance to the producing countries, most of which are developing or under-developed countries. For some of these major shrimp producing countries, the earnings from fresh and frozen shrimp export rank within the top export commodities.

The total worth of Asian shrimp exports increased from US$1.3 billion in 1984 to an estimated US$4.3 billion in 1993. This had increased to over US$5.2 billion in 1995 (FAO, 1997). A major portion of the exported shrimp came from aquaculture farms.

In the case of Bangladesh, for instance, shrimp exports brought in US$181.2 million in foreign exchange in 1995, comprising a significant 5.7% of total export earnings. Shrimp was the No. 3 export of the country.

Thailand, the world's top producer of farmed shrimp, is also the largest exporter. In 1995, it exported US$1,974.2 million worth of farmed shrimp, about 3.5% of the total value of the country's exports. Shrimp was among the top five commodities in terms of value of export earnings generated.

India, another major producer of shrimp, earned US$778.2 million from exports of shrimp in 1995. This was about 2.5% of the value of all exports from the country in that year.

Indonesia's exports of shrimp were valued at US$875.4 million, comprising 1.9% of its total exports. The Philippines earned US$214.8 million in shrimp exports in 1995; this was about 1.2% of total export earnings. China's earnings from shrimp exports amounted to US$297.7 million, about 0.2% of its total exports.

## FOREIGN INVESTMENT

A significant amount of investment in shrimp culture projects and related activities in producing countries comes from abroad. This foreign investment is most welcome for the producing countries as it brings capital inflow and much needed foreign exchange earnings to the often economically underdeveloped or developing countries. While exact figures on the amount of capital inflow through foreign investment are not readily available, it is believed the amount is substantial and gives a boost to the economies of many developing countries involved in shrimp farming.

Examples of foreign investments in shrimp farming and associated sectors in producer countries are many. The Samak Aquaculture shrimp farm in Kedah, Malaysia is a joint venture between the State Government of Kedah and the Saudi Binladin Group. The paid-up capital of the company as at end December 1995 was RM 25.491 million, with 60% of the equity held by the Saudi group. The authorised capital of the company is RM 50 million. Phase 1A and 1B of the project involve 126 and 100 one-hectare ponds respectively and two hatcheries, while a future Phase 2 will include a further 252 ponds. Phase 2 will also incorporate a processing plant and a feed mill (Samak Aquaculture Sdn Bhd publicity brochure).

Thailand, the world's leading shrimp farming country, has seen many foreign players in the course of the industry's development. One of the country's earliest large scale contract farming operation, called Aquastar, was a joint venture between Thai parties and American interests. Trouw International, a subsidiary of the oil conglomerate BP and one of the world's largest producer of aquatic food, held a 40% equity in Aquastar. While the actual financial investment is unknown, the project involved some 1,000-1,200 hectares of shrimp ponds, a feed mill and processing plant (Lacsamana, 1991), indicating that substantial financial resources were committed. The company has since undergone a change of ownership. Other foreign players in the Thai shrimp industry have come from many countries including Taiwan, Japan, USA, Norway and Canada (Saulnier, 1987).

Indonesia, another major farmed shrimp producer, has also benefitted from large scale foreign investment in its industry. One large "transmigrasi" project, initiated by PT Central Pertiwi Bratasena, is a joint venture between Indonesian, Thai (CP Group) and Hong Kong parties. The company has plans to develop 24,000 ha in North Lampung, Sumatra and already runs an intensive transmigrasi project in Lampung. PT Monodon Kencana operates a joint venture farm with Nichiro of Japan, integrating a hatchery, consultants and small boats. Five hundred hectares were in operation in 1992. Hanaqua Corporation of Taiwan is cooperating with PT Bosuwa Isuma in the operation of 10,000 ha of shrimp ponds in South Sulawesi (KONPHALINDO, 1996). These are just a few of the ventures involving foreign participation in Indonesia. As in the case of other countries, while the exact amount of foreign capitalisation is unknown, it is believed to be considerable since the projects are usually large vertically integrated operations involving farms, hatcheries, feed mills, processing plants, etc.

## FOOD PRODUCTION

One of the major benefits of shrimp aquaculture is that it produces food for human consumption. Even though the bulk of shrimp production is targeted for the export market and is consumed by generally higher income consumers in the importing countries, the fact remains that shrimp aquaculture provides food for feeding people. Mixed, alternate cropping or polyculture of shrimp with finfish or other aquatic products can also provide food for direct local consumption.

Farmed shrimp amounted to about 693,000 mt in 1996, which accounted for almost one-third of the total shrimp production from both wild-caught and farm-raised sources. About 75% of the production came from Asia while Western countries produced the remaining 25%. Thailand was the leading producer (160,000 mt) followed by Ecuador (120,000 mt), Indonesia (90,000 mt), China (80,000 mt), India (70,000 mt), Bangladesh (35,000 mt), Viet Nam (30,000 mt), and the Philippines (25,000 mt). Other notable producer countries were Mexico, Honduras, Peru, Malaysia and Nicaragua (Table 2) (Rosenberry, 1996).

The black tiger shrimp (*Penaeus monodon*) was the most important species farmed, accounting for 58% of culture shrimp production, followed by the Western white shrimp (*Penaeus vannamei*) at 22%. Other species farmed included *P. stylirostris, P. chinensis, P. japonicus, P. penicillatus, P. merguiensis* and *P. indicus.*

## POVERTY ALLEVIATION

Poverty alleviation is an important development objective to which aquaculture, including shrimp aquaculture, can contribute (Islam and Jolley, 1996). The living standards of economically backward communities such as fishermen and farmers can be improved through their involvement in shrimp and other types of aquaculture activities. Shrimp aquaculture helps provide a more stable and generally higher income than fishing or other agricultural activities such as rice farming. Since returns from shrimp aquaculture can be forecast in advance with a reasonable degree of confidence, this provides a sense of stability and peace of mind to the shrimp farmer compared to the more uncertain nature of, say, fishing.

A 1996 survey of 400 intensive shrimp farmers in Thailand showed the majority of them were previously rice farmers or fishermen (Phillips, 1997). The attractive incomes that can be realised from shrimp farming were among the factors that prompted them to move into the sector. This illustrates the fact that shrimp farming not only aids in poverty alleviation but also contributes to diversification of employment opportunities in coastal areas. Such positive contributions of shrimp farming towards the development of local people need to be strengthened.

Many former fishermen who have made the switch from fishing to shrimp farming report an improvement in their livelihoods in terms of better income and improved living conditions. Singh and Brenner (1995) observed that shrimp farmers in the Chanthaburi province of Thailand were usually better off than people practising other economic activities. The average daily wage on shrimp farms in Thailand was estimated to be Baht 433, which is 2-3 times the minimum wage in the country (Patmasiriwat, 1997). In addition, part-time people engaged in catching wild postlarvae in Ecuador earn as much in 2-3 days of moon tides as they can in one month as agricultural workers (Robadue, 1995).

## EMPLOYMENT OPPORTUNITIES

Shrimp aquaculture generates considerable employment opportunities not only in developing countries but also in the (usually) developed importing countries. Employment opportunities are created in the shrimp farms as well as associated activities such as hatcheries, processing plants, feed mills, ice factories, and companies supplying equipment, drugs and chemicals, cold storage plants, exporting companies, etc. Employment opportunities are also created in the countries which import shrimp, such as in repacking or processing plants, seafood restaurants, market chains etc. An important aspect is that shrimp farming and related activities provide employment opportunities not only for men but also for women.

At the farm level employment is created at both the management (technical, administrative and marketing) and farm worker level. Farm workers are needed to perform routine jobs such as feeding, pond repair and maintenance, pond liming and fertilisation, harvesting, packing, etc. In the associated activities, workers are needed for hatchery operations, sale of feed, chemical and other inputs, and in post harvest and processing operations. Exact numbers of people employed in shrimp farming and associated industries are not known but examples provide some indication.

A survey of shrimp farms in Thailand classified farm labour into family labour, permanent hired labour and temporary hired labour. The survey showed that for a typical farm, there were 1-2 family labour actively engaged in rearing and pond management and usually 1-2 permanent hired labour to assist family labour. Usually labour was also hired on a temporary basis to perform certain activities such as harvesting, pond digging and cleaning of pond bottom (Patmasiriwat, 1997).

Estimates of the number of people employed in shrimp farming in Thailand vary. Kongkeo (1995) puts the total number of workers employed by the shrimp culture industry and related businesses (input supplies, support services and handling and processing) at more than 150,000, with 97,000 directly involved in shrimp farming. On the other hand, Singh and Brenner (1995) estimated the total number of people directly employed in shrimp farming in Thailand at 114,000 people, based on a survey conducted in 1994.

In Ecuador, some 1,567 firms were involved in shrimp farming and processing and in hatcheries, employing 195,000 people in 1992 (Robadue, 1995). There were, in addition, some 17,000 part-time people engaged in catching wild postlarvae. The shrimp farming industry in Ecuador is reported to be one of the country's largest employers.

In Honduras, the National Association of Shrimp Farmers of Honduras (ANDAH), whose members are generally owners and operators of large farms estimates that shrimp farming generates about 1.5 jobs per ha or a total of 25,000 direct jobs (ANDAH, 1990). In the Gulf of Fonseca area of southern Honduras alone, the Chamber of Commerce of the provinces of Choluteca and Valle estimated that the shrimp industry provided employment to some 11,900 people (90% women) through 25 commercial farms, six packing plants, and six ice making operations (Vergne *et al*, 1993).

Even Malaysia, which has a relatively small shrimp farming industry, has about 3,700 persons directly employed in the sector (Department of Fisheries, Malaysia, pers. comm.). Many more than this number are involved in the associated support activities such as feed, chemical, and equipment supply and the packing, processing and ice making sectors.

Employment generated by shrimp farming compares favourably with some other agricultural and traditional activities in coastal areas. A survey of around 5,000 diverse shrimp farms in Asia showed that intensive shrimp farming provided an average of 558 person-days/ha/yr of labour (with a wide range, from 69 in the Republic of Korea to 1,044 in Thailand). Semi-intensive shrimp farming provided a similar amount (558 person-days/ha/yr on average) of labour but traditional/extensive farming systems gave a much lower 192 person-days/ha/yr.

The employment potential of semi-intensive and intensive shrimp farming still compares favourably with multiple use traditional coastal activities such as rice, mangrove crab and timber collection. Employment figures for rice farming are commonly reported at around 200-250 person-days/ha/yr. The major proportion of shrimp farmers in Asia are small scale farmers rather than large scale commercial operations, where employment potential is generally lower, and this further highlights the significant contribution that shrimp farming is probably making to employment generation.

## RURAL DEVELOPMENT

Shrimp culture projects, like most aquaculture projects, are usually located in remote rural areas. These areas are often backward and undeveloped without basic facilities such as electricity supply, piped water, road and communication systems, etc. The setting up of shrimp aquaculture projects in such areas often helps to stimulate the development of the areas resulting in the provision of various amenities.

Many areas around shrimp aquaculture projects benefited from various improvements which came about after the shrimp projects were set up. Improvements were in the form of electricity supply, municipal water supply, new or improved roads, telephone and other communication facilities, transportation, employment opportunities, etc. Shrimp culture projects also help stimulate small businesses in the vicinity of the farms. There is usually also a tendency for the value of land in the area to experience a sharp increase in value. All this tends to attract more people to the area which further contributes to the development of the area concerned.

The "transmigrasi" programme of the Indonesian government, where large nucleus estates of shrimp farms are set up in less developed parts of the country, is an example of shrimp farming helping in the economic development of rural areas. The programme also incorporates the transmigration of people from heavily populated parts of the country to the less densely populated regions where the nucleus estate shrimp farms are located.

## HUMAN WELFARE

Shrimp culture also has a role in human welfare as many employees of shrimp farms are provided certain fringe benefits and amenities. These include provision of permanent or temporary housing on-farm or nearby, daily meals, and financial allowances besides their basic wages. In the case of large farms, workers who do not stay on-site may also be provided with transport to and from work. Farms may also have sports and recreational facilities for the use of their staff and small convenience stores where employees may purchase day-to-day needs.

The expansion of shrimp farming has also had an impact on the education system and the educational level of local youths. Because of the attraction of well-paid jobs in shrimp farms and related installations, there has been a surge in the number of students opting for fisheries and related courses in colleges and universities. The institutions of higher learning have also reorganised curricula so as to offer more courses which train students for jobs in shrimp farms and related sectors. The educational level of local youths, especially in relation to fisheries education, has thus improved as a result of the expansion of shrimp farming.

## TECHNOLOGY TRANSFER

The setting up of large scale farms through foreign investment has helped to facilitate the transfer and update of technology in shrimp culture and related fields from the advanced countries to countries which may have been lagging behind in the technology or which are still using outdated technologies in their culture operations. Such technology transfer can occur through the technical expertise brought in by the shrimp farming concerns.

Among the experts which may be brought in for shrimp farming operations are shrimp maturation and spawning experts, nutritionists, growout experts, pond engineers, processing experts, financial managers, etc. The spillover effect of the inflow of such technology benefits the recipient country especially the poorly developed or developing countries which many shrimp farming countries are. There is much potential for increasing the productivity of traditional ponds in countries using less than optimal farming technologies in countries such as Bangladesh and India.

## SOCIOECONOMIC ASPECTS

Shrimp aquaculture has also been used as a means of alleviating or addressing various social and economic problems. Governments have tried to use shrimp aquaculture as a way to raise the economic status of poor or backward communities (eg fishermen, farmers) by involving them in shrimp culture programmes. Shrimp and related aquaculture programmes have been used to transfer out surplus manpower from economic sectors which have too many people for the existing resource to support (eg capture fisheries).

Shrimp aquaculture has also been used to relocate people away from densely populated areas to less densely populated localities so as to reduce pressure on local land and other resources and to stimulate the development of less developed parts of the country. The “transmigrasi” programme sponsored by the Indonesian government is an example of this. Under this programme, families from heavily populated areas such as West Java are invited to be involved in “nucleus estate” shrimp farms set up jointly by the government and private companies in new areas such as East Kalimantan, Sulawesi and Sumatra.

The nucleus estate concept involves the construction of a vertically integrated “nucleus” and a sharecropping “plasma”. The nucleus consists of an integrated intensive farm including a hatchery, processing plant, and a complex of intensive ponds which are operated by farm employees. The “plasma” consists of semi-intensive ponds operated as family farms on a sharecropping basis. The nucleus not only provides fry, feed, processing and marketing, but also housing for the families involved. Apart from helping to bring development to remote areas and serving the national objective of redistributing heavily concentrated populations, the concept utilised under the “transmigrasi” programme of Indonesia produces a valuable export commodity for the country (Chamberlain, 1991).

Several projects under the “transmigrasi” programme have been set up involving the opening up of considerable areas of land and substantial numbers of transmigrasi families. PT Dipasena Citra Darmaja is involved in a 16,000 ha project in Lampung, Sumatra incorporating 7,000 plasma farmers. PT Cipta Windu Khatulistiwa is involved in a similar project in Jawa, Sambas, West Kalimantan involving approximately 650 transmigrasi families and a potential land area of 10,000 ha. PT Tekad Andhika Dharma cooperates with PUSKOPAD (Pusat Koperasi AD) in a transmigrasi project in Surabaya involving 1,000 smallholders (KONPHALINDO, 1996). These are just a few of the projects implemented under the transmigrasi programme. While the total number of projects, the extent of land area and the exact number of people involved may not be known, these examples serve to illustrate the scale of these projects.

The capacity of shrimp aquaculture to create employment opportunities also helps reverse the general tendency for rural youths to migrate to urban areas thus helping to retain their skills in the rural areas.

## TOURISM

Many shrimp farms receive and arrange tours for visitors who are interested to find out more about the way a shrimp farming operation functions. In fact some tourist resorts have incorporated shrimp culture ponds as part of their facilities. Besides attracting visitors to the resort, the shrimp ponds often also perform an additional function of providing an exotic food item for the resort’s kitchen to serve to the guests. Although difficult to assess in quantitative terms, this is another spin-off benefit of shrimp culture.

## ENVIRONMENTAL PROTECTION

One of the root causes of environmental deterioration and destruction is poverty (Islam and Jolley,1996). In the search for food and income, people have sometimes contributed to the deterioration of valuable coastal ecosystems such as mangroves and caused the near-depletion of certain organisms (eg mangrove crabs) through excessive collection. Shrimp farming, if practised in the appropriate way with the involvement of local people not only can contribute income and food sources for marginalised coastal inhabitants, but also prevent some of the environmentally damaging activities which they may otherwise be forced to resort to.

As an example, non-governmental organisations (NGOs) in northern Vietnam are promoting coastal aquaculture, including shrimp, crab and seaweed culture, as components of mangrove replanting projects, and as income generating alternatives to mangrove destruction (Duc, 1996). In these projects, shrimp provides income through sale to other consumers while the other crops provide food for their own direct consumption.

## CONCLUSION

The foregoing discussion shows that there are many positive benefits which result from shrimp aquaculture. However, it is important that shrimp farmers ensure that their farming practices are environmentally friendly and sustainable so that adverse environmental and socioeconomic impacts can be minimised. A Code of Practice for sustainable shrimp culture should be developed to guide farmers in adopting good culture practices and methodologies. This would go a long way towards enhancing the benefits of shrimp culture.

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**Table 1: Exports of Shrimp in Relation to Total Exports for Selected Countries**

| Exports | Total Exports | | Shrimp/Total Exports | |
|---|---|---|---|---|
| | (mt) | (US$mill) | (US$bill) | (%) |
| Thailand | 165,661 | 1,974.22 | 56.7 | 3.5 |
| Indonesia | 76,565 | 875.32 | 45.4 | 1.9 |
| India | 101,751 | 778.1 | 30.7 | 2.5 |
| Philippines | 17,826 | 214.83 | 17.5 | 1.2 |
| Bangladesh | 21,128 | 181.23 | 3.2 | 5.7 |
| China | 47,052 | 297.71 | 148.8 | 0.2 |

Source: (FAO, 1997)

**Table 2: World Farmed Shrimp Production – 1996 (in mt)**

| | |
|---|---|
| **Eastern Hemisphere** | |
| Thailand | 160,000 |
| Indonesia | 90,000 |
| China | 80,000 |
| India | 70,000 |
| Bangladesh | 35,000 |
| Vietnam | 30,000 |
| Philippines | 25,000 |
| Malaysia | 4,000 |
| Sri Lanka | 2,000 |
| Australia | 1,700 |
| **Total Eastern Hemisphere** | **520,700** |
| **Western Hemisphere** | |
| Ecuador | 120,000 |
| Mexico | 12,000 |
| Honduras | 10,000 |
| Peru | 5,000 |
| Nicaragua | 3,000 |
| Belize | 2,000 |
| Venezuela | 2,000 |
| United States | 1,300 |
| Costa Rica | 1,000 |
| Others | 16,000 |
| **Total Western Hemisphere** | **172,300** |
| **World Total** | **693,000** |

Source: World Shrimp Farming 1996 (Bob Rosenberry)

# VIEWPOINT ON FORMULATING POLICIES FOR SUSTAINABLE SHRIMP CULTURE

By

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## 1. INTRODUCTION

The “gold-rush-days" of shrimp culture is over. Heretofore, there was a mad rush to build shrimp farms and hatcheries in one country after another. Then, just as suddenly, an increasing number of shrimp farms and hatcheries are being abandoned and left idle as production failed and large financial losses incurred. Where before, shrimp culture was being hailed as a very promising investment venture by both governments and businesses, it is now being vilified as mangrove killer. Where before, shrimp farms were the one complaining about pollution from other industries, they are now the objects of complaints from small-scale fishers for polluting the coastal environment. It is such an abrupt role reversal that as late as 1994, aquaculture in general was still described as a "non-consumptive user of water since water used in aquaculture is released to the environment while still being of very high quality." (Piedrahita, 1994).

After having formulated all sorts of incentives to encourage investors to venture into shrimp farming, governments all over are now in the throes of formulating policies, which would in effect curtail shrimp farming. The days of "slash-and-burn" type of shrimp farming are numbered if not yet totally gone. In the rush to put in place certain regulatory measures it is well to review point by point just what aspects of shrimp farming ought to be, and can realistically be, regulated. Otherwise the regulatory measures instituted might result in a "throwing-the-baby-with-the-bath water" type of situation.

This paper shall examine all the negative impacts attributed to shrimp culture, particularly to intensive shrimp culture, review the remedial measures often recommended to ameliorate their ill effects and discuss the implications and practicability of the suggested measures

## 2. IMPACTS OF SHRIMP CULTURE

The negative impacts of intensive shrimp culture and aquaculture in general has been listed and discussed in various publications. In 1991, the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) already provided a comprehensive list of environmental impacts of coastal aquaculture most of which were applicable to shrimp culture. One of the most succinct and comprehensive reviews of the impacts of shrimp farming on the coastal environment was done by Primavera in 1993. While specifically describing the Philippine situation, the said review has global applicability. Other literature while not as comprehensive discussed certain key issues such as mangrove destruction at greater length (Hambrey, 1996; Lassen, 1997). The following listing while based largely on the above-mentioned papers also picked on other sources as well as the author’s personal knowledge for details and emphasis.

### 2.1 Loss of Mangrove Ecosystems

The destruction of mangrove ecosystems is always cited as the most significant negative impact of shrimp culture. It is also always the most emotional issue. With it the consequent loss of goods and services, which could have been availed of by the coastal populace, most of whom are economically disadvantaged, is often included as well. Although all too real, it should be taken in its proper context. As Lassen (1997) pointed out "the impact is less dramatic if considered on a larger scale. In fact if all shrimp ponds in the world are assumed to have been constructed in mangrove regions, then less than 5% of the global mangrove resource would have been directly impacted." Macintosh (1966) also points out that “aquaculture is but one of several ‘development’ activities which have contributed to the huge loss of mangrove resources worldwide.

Often not recognized is the fact that in many Asian countries where aquaculture is an established tradition, the destruction of mangrove preceded the emergence of shrimp culture technology. Most of the mangrove-based shrimp farms in the Philippines as well as in Indonesia and Thailand started out as extensive fishponds and merely shifted to shrimp culture when the technology emerged. In the Philippines, 168,118 hectares of mangroves have already been converted into fishponds by the seventies, long before shrimp culture technology was developed (Primavera, 1993). In Thailand it is estimated that 65,000 hectares were initially cleared for other purposes before these were subsequently developed into intensive shrimp farms (Lassen, 1997).

This is not to say that mangrove destruction should go on unabated. With the growing awareness on the importance of mangroves, most governments such as the Philippines have already banned the destruction of whatever little mangrove forest there are still left. Mangroves used to be considered an ideal site for aquaculture because it can naturally be watered by tidal action. Once shrimp farming progressed beyond mere "entrapment or pond-based capture of wild shrimps" (Fegan, 1997) pumping became essential and the mangrove lost its only natural advantage. In fact it has become clear that mangrove is generally not suitable for shrimp culture due to potential acidity of the soil once exposed. As Fegan (1997) has pointed out, this information is poorly disseminated to the private sector and mangrove areas continue to be used.
It seems apparent that it should not be too difficult to discourage the further destruction of mangroves for shrimp culture is on the basis of site suitability through better dissemination of the said information. However the recent introduction to Asia of plastic pond liners for shrimp farming may blunt the effect of such information drive. Plastic liners effectively prevent soil-water interaction and thus skirt the problem of soil acidity.

### 2.2 Organic Loading and Pollution

During the course of one culture cycle, a large volume of organic matter is generated. Lin (1995) estimates that this can range from a low of 500 kg per metric tons of shrimps produced at a feed conversion ratio (FCR) of 1.0 to 1,625 kg at an FCR of 2.5. Organic matter includes uneaten feed, shrimp feces, exuvia from molting, and the dead bodies of shrimps which did not survive. These would generally settle on the bottom and are only partly discharged during regular water change. During harvest a large portion is also flushed out to the outside environment, but depending upon pond design and construction a larger portion may also remain on the pond bottom. The amount discharged generally depends on the pond design. It does not take long for such materials to partially decompose into black foul-smelling muck. The degree of success in shrimp pond operation often depends on how well the build upo f muck is managed.

Since the amount of muck generated increases in proportion to the stocking density, the solution often suggested is to impose limits either on the density of shrimps within a pond or the density (or hectarage) of ponds within a given area or both. Imposing limits on stocking density effectively limits shrimp farming to extensive and at most semi-intensive operations. The other approach of limiting the number or hectarage of ponds to be allowed will require an estimation of an area's carrying capacity.

### 2.3 Nutrient Enrichment and Eutrophication

Together with the solid wastes are of course the soluble inorganic nutrients (nitrogen and phosphorus) which have the potential to cause nutrient enrichment and eutrophication. These nutrients include those coming from fertilizers and those leached out from feeds. Not surprisingly concentration of these nutrients in effluent waters from shrimp farms is always found higher than in influent water with the actual volume varying according FCR. Again like that of solid wastes, the concentration of nutrients in discharge water rises in direct proportion to the stocking density and in negative proportion to the FCR. Thus the same recommendations are often suggested to minimize enrichment, that is reduce stocking density and or the number and hectarage of ponds to be allowed in an area.

### 2.4 The Use of Bio-active Materials

The use of bio-active materials or bio-remediation is now being applied to shrimp farms to hasten the decomposition of organic materials and prevent the build up of muck. Many growers have reported on their efficacy. Originally developed for the treatment of sewage, such bio-active materials consist of selected strains of bacteria and enzymes. Because these materials are proprietary in nature some manufacturers often keep the actual identity of the microorganisms involved a trade secret. Furthermore these products have mostly been developed in other countries. Because of this come concern has been raised on their safety and possible effects on the environment.

### 2.5 Longevity and Toxicity of Chemicals to Non-target Species

Various chemicals are used in shrimp culture both during preparation and during operation. These include lime, chlorine compounds, formalin, algicides, piscicides and bactericides including antibiotics. Some, such as lime are known to be benign while others are either completely biodegradable such as teaseed powder. The real danger lies with those that are known to persist in the environment such as certain chemical pesticides – particularly those originally developed for agriculture, and antibiotics. Some countries, such as the Philippines, have already banned the use of many of the agricultural chemicals. However there appears to be no regulation in place yet on the use of antibiotics. Market requirement for antibiotic-free product has forced growers to practice a withdrawal period before harvests but has not completely stopped the use of antibiotics. While studies have been made on the half-life and longevity of certain agricultural pesticides, little is known about the fate of antibiotics once these have been applied.

### 2.6 Development of Antibiotic Resistance

The impact of antibiotics goes beyond its immediate effect on non-target organisms. The capacity of bacteria to gradually develop resistance to a particular antibiotic is already well know. Because the antibiotics used in aquaculture are no different from those used in medicine, this aspect is of serious public health concern. There were reports for instance that in the province of Iloilo, Philippines, public health workers have noted that tuberculosis was no longer responding to Rifampicin (generic name: Rifampin). Is this due to the fact that Iloilo has one of the largest concentrations of shrimp hatcheries in the country and that Rifampicin is known to be routinely used as a prophylaxis in hatchery operation?

### 2.7 Species Introductions and Spread of Diseases

Even before the word globalization was in vogue, some shrimp species have already become globalized. First and foremost is the black tiger, *P. monodon.* Because it was known to be the fastest growing and the biggest, there were considerable interests in acquiring *P. monodon* stock both for R & D and possible production. It reached as far as U.K. and Panama, among others. Iran also brought a trial stock of P. *monodon* from Malaysia in the early 90's with the original intention of eventually establishing a captive broodstock. Similarly *P. vanamei* has been brought to Tahiti, the Philippines and China, while *P. chinensis* has also been brought to the Philippines.

Aside from the usual caveats against the introduction of exotic species, there is a real danger of spreading diseases. One of the most notable was the near-collapse of the kuruma shrimp (*P. japonicus*) aquaculture in Japan after some growers started using kuruma shrimp PL's from Taiwanese hatcheries which turn out to have been infected, (Mr. Hideo Mochizuki, Mitsui Norin, Kagoshima, Japan, pers. comm.).

Cross border introductions especially if it has to cross oceans is probably one of the easiest to control. The Islamic Republic of Iran did not pursue its plan of going into *P. monodon* culture and has adopted a policy of using only locally available species (*P. semisulcatus*) for their shrimp production following the recommendation from the FAO shrimp culturist assigned to implement a UNDP funded project (IRA/89/041). The Philippines has a general prohibition against the import of live crustaceans of any stage, however exemptions can be granted for experimental purposes provided it is accompanied by a proper health certification from a recognized authority and safeguards can be guaranteed by the importer. But one can get complacent if the animals being brought in are technically non-exotic; being already endemic in the country as was the case of the kuruma shrimp PLs from Taiwan to Japan.

### 2.8 Decline in Natural Stock of Shrimps and other Species

This issue is not always mentioned as one of the negative impacts. This is due to the fact that at commercial scale production, a hatchery is essential. However the Indian government appears to consider this a serious issue since the use of wild-caught fry is included as one of the "don'ts" in their guidelines for sustainable brackishwater aquaculture. (Anon, 1997). This is probably because shrimp fishing is an important industry in India and shrimp fry supply from hatcheries used to be inadequate to serve the shrimp culture industry when it was still taking off and before the Indian Supreme Court imposed a severe restriction on shrimp aquaculture.

There is another dimension to the use of wild-caught fry, the unavoidable collection of the fry of other species as well as by-catch. According to Clay (1997), "estimates indicate that the by-catch from the post-larvae industry is twice the rate of wild caught shrimp which is as high as 10 to 1." Ecuador, during the period of rapid growth in the early eighties relied heavily on wild caught postlarvae since there were not enough commercial hatcheries at that time (Stern, 1995).

Even with the proliferation of hatcheries however, it is known that virtually all hatcheries for *P. monodon* still rely on wild-caught spawners and broodstock. Heavy exploitation of the breeding population has to have an ecological cost. In any other fisheries, it is precisely the breeding stock that is protected. Many hatcheries are known to release over-size, unsold PL's as well as "left-overs" to the sea. Instead of relying on voluntary releases definite policies maybe instituted to ensure unabated recruitment into the natural stock. In the meantime the use of pond-grown captive broodstock should be encouraged.

### 2.9 Water and Soil Salinization and Land Subsidence

Soil salinization and land subsidence are separate but inter-related issues. One is caused by the pumping of saltwater from the sea into arable lands and the other by the excessive withdrawal of water from the ground. Both can result in the salinization of the aquifer, so the three issues are logically discussed together.

Soil salinization occurs when land hitherto unreachable by the sea because of its elevation, is flooded with saltwater with the use of pumps. More often these are prime agricultural lands such as in East Java, Indonesia (Yap, 1990) or in Negros Occidental, Philippines. This practice in fact seems contrary to the usual human instinct to push back the sea and reclaim land.

Once pumped up, saltwater can seep through the dikes and pond bottom and contaminate adjoining croplands or filter down to the aquifer and render the ground water unusable. Another way for groundwater to be salinized by shrimp culture is when a shrimp farm pumps a huge amount of freshwater to manage the salinity to optimum levels. Upon depletion, the groundwater can gradually be replaced by saltwater resulting in its salinization. Unmitigated drawing of ground water also causes the land to sink as happened in Taiwan.

### 2.10 Privatization of Resources

This issue is the social dimension of the mangrove-destruction issue. The conversion of mangrove swamps into shrimp or fish ponds transforms a multiple-use, multiple user resource into a single-purpose, single-user thus further marginalizing already poor coastal communities (Primavera, 1993).

While this is a serious issue, it should be pointed out that it is very much wider than shrimp culture or aquaculture for that matter. Like the destruction of mangroves, the purpose for its becoming a single-user resource can be as many as there are human activities and enterprises. Shrimp farming just happens to be one of them. At the heart of the matter is government policy not on shrimp culture per se but on land conversion, development and ownership.

### 2.11 Competition for Land, Credit and Commercial Products

During the heyday of shrimp culture, banks were literally pushing their money to finance shrimp production projects. Furthermore such projects, because they were expected to yield quick and high returns, were able to pay more for the land they need. However the fact that banks favors the large corporations and the elite over the marginal farmers and small entrepreneurs is a fact of life in a market economy and is not unique to shrimp culture. That shrimp farming competes with other activities over land use is only true to a certain extent since shrimp farming is site specific. At any rate this issue has become moot and academic with the general decline of shrimp culture everywhere. With so many failed shrimp production projects, banks everywhere are now reluctant to fund new ventures.

### 2.12 Decline in Domestic Food Crops

Any pond used for growing shrimps is one less pond for growing fish. Thus the culture of shrimps, a cash crop for export, is perceived to reduce the supply of food crop for domestic consumption. Primavera (1993) cites as evidence the shift in pond hectarage milkfish to the "more lucrative shrimp crop destined for foreign markets." This is only partly true however because intensification in remaining areas and the use of fish pens more than offset results of reduction in milkfish production area.

### 2.13 The "Fish Meal Trap"

Shrimp feed requires a large quantity of fishmeal. Fish that could otherwise be used directly for human consumption goes into the production of a luxury crop. Until a suitable substitute for fishmeal can be developed, this situation will likely remain. This is an important issue that has to be resolved.

This is an issue that is governed more by market economics. For as long as so-called "trash fish" cannot be profitably marketed as food fish due to lack of demand within the locality where it is fished from, then it will be converted to fish meal. Case in point is the Philippines. Because the Filipinos are not discriminating as to the type and size of fish, there is no "trash fish" as such. "Trash fish" in the Philippines refers to fish which due to poor handling are no longer fit for human consumption and could more be more slavaged only by converting into fish meal (which are naturally of poor quality).

## 3. AN ASSESSMENT

Of the 13 impacts, not all have policy implication vis-à-vis shrimp culture sustainability. Some of the social issues such as privatization of resources, competition for land and credit may not have direct relevance to shrimp culture since they apply as well to other enterprises. Similarly the issue of mangrove destruction although highly charged, goes beyond shrimp farming or aquaculture. What are truly germane to shrimp culture sustainability are the problems of organic loading, enrichment, use of chemicals and antibiotics, soil and water salinization and heavy use of fishmeal.

Nevertheless, whether they have direct or indirect relevance to shrimp culture sustainability any discussion towards policy formulation has to address the following questions:

- Should new shrimp farms be allowed in mangrove areas?
- If shrimp farms are to be disallowed will be fish farms be allowed?
- What about the existing shrimp farms and fish farms that have already been developed long before the alarms was raised on mangrove destruction?
- Should stocking density limits be imposed on shrimp farming and relatedly should such limits be limited to shrimp farming;
- Should the number or hectarage of shrimp farms be limited in a given area?
- Should the conversion of good agricultural lands for saltwater aquaculture be allowed?
- Should there be limits to the sizes of shrimp farms in order to have more equitable distribution?
- Should the pumping of ground water for shrimp farming be allowed?
- What kind of chemicals can or cannot be used?
- Should antibiotics be allowed in any aquaculture operation?
- Should manufacturers of bioactive materials be required to openly label their products?
- Should shrimp hatcheries be required to release a set proportion of their fry produced to stock the seas?
- Should there be limits set on how much fishmeal can be allowed for the production of shrimps?

### 3.1 The Mangrove Issue

The mangrove issue goes beyond national boundaries. Already there are reports that US based environmentalists are now lobbying for a ban on shrimp imports from countries producing shrimps from mangrove areas after their success on the turtle issue. This issue is more serious than the use of turtle exclusion device in capture fisheries since most shrimps are now produced from aquaculture than from capture fisheries. As Lockwood (1997) pointed out, a serious international conflict is developing, one that would pit "market economies, survival economies, and nature's economy – the environment."

It should be said that such a move towards a "mangrove-friendly" shrimp can be construed as another example of Western double standard unless it is qualified so that only those still allowing the conversion of mangroves into shrimp farms shall be covered. Otherwise by the same token one can possibly move to boycott or ban American wheat. After all the amber waves of grain couldn't have been possible without destroying vast tracts of native grasslands, which like the mangroves also supported a diverse fauna, resulting in the near decimation of the bison. What is done, is done. It just so happens that what was before considered wastelands that has to be cleared and planted like the mangrove and the prairies are now considered valuable ecosystems.

While it is a fact that more mangroves has been destroyed for aquaculture development than has been necessary, it would be unrealistic to move towards condemning all shrimp ponds and fish ponds and requiring their restoration to their original state as mangrove forests. Such a drastic move can cause a tremendous amount of economic dislocation on the part of those affected.

In the case of the Philippines there is a need at the very least to enforce existing laws which require the preservation of a minimum of 20 meters of mangrove along shorelines facing the sea, rivers, and tidal creeks. Then as a stronger step there should be a thorough inventory of the existing brackishwater fishponds. Those which have been abandoned or have been unproductive because of their marginal conditions should have their fishpond lease agreement cancelled, and the area restored as mangroves. There is ample precedent for such moves. In several instances in various parts of the Philippines, dikes encroaching on riverways have been blasted due to pressure from affected citizenry once these were found to be the main cause of flooding.

### 3.2 Limiting Stocking Density and Pond Hectarage

One issue where there ought to be no conflict between shrimp growers and non-shrimp growers is that of organic loading, pollution and enrichment. Aquaculture is unique in that unlike other industries it is also adversely and directly affected by the waste it generates. Effective waste treatment and pollution abatement can be considered the core of sustainability. It is as much to the interest of the shrimp culture industry to clean up its own wastes as it is to the community at large. This should now be increasingly clear to most growers.

Limiting the stocking density within farms or limiting the number of farms within an area will no doubt work, however there are three questions that can be raised to such move:

- How can farms be monitored for compliance with the density limits?
- How can the number or hectarage of farms to be allowed in an area be determined?
- Is it feasible or even technically possible to determine the carrying capacity in all the shrimp growing areas?

Imposing limits on stocking density stifles productivity and efficiency. Should we be content at producing a few hundred kilograms per hectare when potential production can be several metric tons? There is also insufficient baseline data to compute carrying capacities of a given area. It is one of those easier-said-than done ideas.

Viewed objectively it is not the number of shrimps per se that impacts negatively on the environment. Instead it is the amount of waste generated by the shrimp stock, which has a negative impact. If a shrimp farm can successfully manage its waste so that it no longer affects the environment should it still be punished for exceeding the limits imposed? Just as governments do not dictate normally dictate the output of manufacturing plants leaving this to the discretion of the operator who would conceivably base this on plant capacity and market, then perhaps no limits should be imposed on shrimp stocking density. However the government, in the name of public health and safety, should have the right to impose standards on the waste discharge be it from a manufacturing plant or a shrimp farm.

With such approach any shrimp farm can determine its own stocking density based on its capacity to manage its wastes. A zero-discharge system is technically possible. What remains is to show that such systems can also be financially viable. Even if a zero–discharge system is not yet commercially viable the technology now exists for managing such wastes so that organic loading and enrichment can be greatly minimized. Waste discharge quality, both during operation and at harvest, will definitely be easier to monitor than stocking density.

### 3.3 Antibiotics

What are not yet evident to aquaculture practitioners in general and shrimp growers in particular are the dangers of using antibiotic. Unlike organic wastes, the effects of antibiotic are not visible. A lot of educating needs to be done to raise the consciousness of shrimp and fish growers on the adverse effect of antibiotic use. It is known that some growers succeeded in producing shrimps profitably even without using antibiotics. Dole Philippines, when it was still in shrimp growing business, made it a policy never to use antibiotics and required feed suppliers to certify that the feed they are selling is completely antibiotics free. Although the company has recently pulled out from shrimp growing business, the decision was reportedly prompted by reasons other than production failures. (Mr. Marlo Tabbu, Dole Phils., Gen. Santos City, Philippines., pers. comm)

### 3.4 Salinization of Land and Water Resources

The use of good agricultural land for saltwater aquaculture can really be considered a shortsighted move since it does not consider the possibility of the industry eventually turning bad. Once salinized, it will be difficult to revert it to its original state so it can be used once more for other crops as happened with the sugarlands in Negros Occ., Philippines when the intensive shrimp culture industry collapsed. Although tangential to the issue of shrimp culture sustainability per se, this is a serious issue which should be addressed.

The pumping of groundwater to bring down the salinity to optimum levels is widely practiced in the culture of *P. monodon*. However not a few growers have found out by themselves that growth in pure seawater at salinity levels of 32 to 34 ppt does not differ significantly for as long as proper husbandry is practiced. This fact should be more widely disseminated and the use of groundwater for salinity control should be discouraged if not banned outright.

Lowering of seawater salinity has also been found by some growers to be unnecessary for the successful growing of the black tiger shrimp. Reportedly the slight difference in growth rate is offset by the savings incured in not having to pump a large volume of freshwater from a deepwell. Again, Dole Philippines used undiluted seawater for their shrimp growing operations in Southern Mindanao.

## 4. BEYOND SHRIMP CULTURE

It should be kept in mind that issues affecting shrimp culture are true for aquaculture in general and are not unique to shrimp culture. This being the case any policy recommendation should cover aquaculture in general and not just shrimp culture.

Case in point is the Philippines. With repeated production failures, most shrimp growers previously practicing intensive culture shifted to intensive milkfish production, using the shrimp growing infrastructure, pumps, paddlewheels and all. From a mere 3,000 fingerlings per hectare, milkfish growers now stock as much as 30,000 per hectare. Some have even been reported to be pushing the stocking rate to 70,000 fingerlings per hectare. From a mere per hectare production of 1,000 kg attainable under a fertilized system, 20 to 30 metric tons is now routinely attained.

With most intensive shrimp farms having stopped their operation, the issue of organic loading and pollution in the Philippines has now shifted to the proliferation of fixed pens and cages in shallow bays and inlets in Lingayen Gulf in the province of Pangasinan as well as in the southern province of Davao Oriental. With fish kills occurring frequently, and with the small fishers complaining about lose of livelihood due to decreased fishing area and lower catch, the local government in Pangasinan recently decided to demolish the fish pens.

Recently introduced to the Philippines are the deep-water ocean cages such as those used for salmon in Europe, and the Americas. At Sual, Pangasinan, there are now 60 units of these 19 m diameter cages. Normally stocked with 50,000 to 60,000 milkfish fingerlings per cage, each cage can consume as much as 40 bags of feed every day during the final weeks of growing and can produce as much as 30 metric tons. Some operators are now trying to push this to the 100 metric ton per cage level by increasing the stock correspondingly. As usual, there are still no regulations to cover the installation of these cages.

Thus as technology is developed or introduced, bold entrepreneurs rush in to use them leaving lawmaking bodies and regulatory agencies behind. They cannot be blamed, neither can they be prevented from doing so. After all aquaculture is a business enterprise. The bottom line is a healthy profit. As is often said the business of business is to make profit. However there is a need to see to it that the process of profit making is not done at the expense of the environment, public health and safety, and the society in general. That is the business not only of the government but also of everyone in general, including business.

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# PROCEDURES TO LESSEN ENVIRONMENTAL IMPACTS OF POND AQUACULTURE FOR USE IN CODES OF PRACTICE

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## ABSTRACT

Major environmental concerns about pond aquaculture and coastal shrimp farming in particular include: disruption of mangrove forests and other wetlands; eutrophication and sedimentation in natural bodies of water caused by pond effluents; salinization of freshwater areas; use of toxic and bioaccumulative chemicals in production; conversion of cropland to ponds; excessive use of resources such as water, foodstuffs, and electricity; negative effects on native fisheries and biodiversity. The Global Aquaculture Alliance, a new multinational consortium of aquaculture producers and marketers, is dedicated to development and promotion of improved practices to enhance the efficiency of aquaculture and prevent negative environmental impacts. A discussion of relatively simple procedures that can prevent or lessen the impacts of pond aquaculture are presented. The principles and procedures provided should be considered in developing "codes of good practice" or "best management procedures" for shrimp farming and other types of pond aquaculture.

## INTRODUCTION

Rapid growth of aquaculture in the past two decades has enabled the world fisheries supply to keep pace with population growth despite the fact that catch from the oceans and inland waters has reached a plateau. It is generally recognized that continued growth of aquaculture is essential if the need for annual increases of world fisheries production of 2 to 3 million tons is to be met. While the rapid growth of aquaculture has been the cause of environmental damage in some areas, such damage need not be a routine consequence of aquaculture. The scientific base for aquaculture is well established. Fish, shrimp, and other aquatic species can be and are being produced in an "environmentally-friendly" manner.

The negative environmental impacts attributed to aquaculture most often have resulted from poor planning, inappropriate site selection and management procedures, and lack of attention to environmental protection. While much of the blame may be placed on rapid expansion , very often, practical aquaculturists did not understand the consequences of their actions. Now, aquaculturists have been learning from their mistakes, just as pioneers in other new industries learned from theirs. Aquaculturists throughout the world recognize that they must take positive steps towards environmental protection, both in the interest of maintaining productivity within their farms and as good citizens and neighbors.

## ENVIRONMENTAL CONCERNS

The major areas of concern are:

- Conversion of mangrove forests and other wetlands to aquaculture farms.
- Eutrophication of natural waters by effluents from aquaculture operations.
- Increased sedimentation in natural water bodies as a result of pond effluents and disposal of pond sediment.
- Salinization of freshwater by pond effluents and seepage into aquifers.
- Use of potentially toxic and bioaccumulative chemicals in production.
- Conversion of crop land to aquaculture farms.
- Excessive use of resources such as freshwater, feed ingredients, electricity, etc.
- Negative effects on native fisheries and biodiversity through habitat destruction, water pollution, impingement by pumps, uses of wild-caught broodstock and larvae, and introduction of non-native species.

## PREVENTION AND MITIGATION

The negative environmental impactions of aquaculture can be alleviated through use of good design and construction methods, operation of aquaculture farms according to better management practices, and consideration for the larger environment. Techniques for preventing and mitigating each of the environment concerns from above will be discussed.

### Conversion of mangrove forests and other wetlands to aquaculture farms

Mangrove forests and other wetlands are not optimal sites for aquaculture ponds. Soils in such locations often are highly acidic and may contain large amounts of organic matter. It is difficult to drain and dry soil to permit use of standard construction techniques. Water exchange by tidal flow in the creeks and channels of mangrove swamps is incomplete and pond effluents may not be washed completely away when discharged. As a result, it is difficult to prevent cross-contamination of intake water and discharge water on farms located in the intertidal zone. Wetlands are located in low lands and pond drainage in such areas may not be complete.

Wetlands and mangrove forests are fragile ecosystems playing an important role in nutrient cycling and supporting large biodiversity. They serve as essential buffer zones between terrestrial areas and water bodies. Mangroves are breeding and nursery grounds for many important species of fish, crustaceans, and mollusks. There is evidence that a decline in mangrove areas can diminish production of coastal fisheries. Most governments are now regulating the cutting of mangrove forests and protecting other wetland areas. Controlled and sustainable use of such world resources is desirable, and it is evident that no type of development will be permitted to clear huge tracts of a wetland in the future.

There is another important inducement for aquaculturists not to destroy wetland areas. Recent researches have shown that mangrove forests and wetlands are highly efficient in enhancing the removal of solids and nutrients from aquaculture effluents (Robertson and Phillips 1995; Schwartz and Boyd 1995). The discharge from aquaculture farms can be directed through mangrove stands and other wetlands to effect water treatment. For coastal aquaculture, this has the combined benefits of stimulating the productivity of the mangrove areas and enhancing coastal fisheries, minimizing pollution of the coastal environment, and providing a higher quality water supply for aquaculture. Aquaculturists should initiate mangrove reforestation and wetland construction projects to provide additional areas for water treatment.

In some circumstances, parts of aquaculture operations need to be established in wetland areas, e.g., inlet canals bringing brackishwater to coastal shrimp farms, drainage canals discharging treated effluents in nearby rivers, and pumping stations. In these situations, careful planning needs to be done before constructing aquaculture farms. Disturbance caused by construction should be kept to a minimum. The canals or other infrastructure should not restrict natural water flows nor interfere with wildlife migration and ranging. Equally important, a management plan should be prepared to prevent further disturbance of mangrove and wetland during the life of the aquaculture project.

### Eutrophication of natural waters by effluents from aquaculture operations

Feeds and fertilizers are used in most aquaculture ponds to stimulate production. Fertilizers increase nitrogen and phosphorus concentrations in pond waters and stimulate the growth of plankton. Photosynthesis by phytoplankton is the major source of dissolved oxygen necessary to maintain aerobic conditions in pond waters and superficial sediment. Feeds are consumed by fish, shrimp and other aquatic animals, but some uneaten feed reaches the pond bottom to be decomposed by microorganisms and converted to inorganic nutrients such as ammonia, phosphate, and carbon dioxide. Cultured aquatic animals convert part of the feed they eat to flesh, but they excrete feces, ammonia, carbon dioxide, and other metabolites. It is not possible to increase production with fertilizers and feeds without causing eutrophication of pond waters. Organic matter from uneaten feed, feces, and dead phytoplankton serves as substrate for microbial activity. Microorganisms can assimilate much of the waste load in ponds. They convert organic matter to carbon dioxide and water, nitrify ammonia to nitrate, and denitrify nitrate to gaseous nitrogen. Phosphate is strongly adsorbed and retained by pond bottom soils.

Ponds are efficient in assimilating organic matter and nutrients if the average hydraulic residence time in ponds is several weeks, and if ponds are not stocked and fed excessively. For example, Schwartz and Boyd (1994) demonstrated for ponds without water exchange that only 3% of carbon, 7% of phosphorus, and 28.5% of nitrogen added in feed was lost in outflowing water including overflow after rains and draining for harvest. Nevertheless, water discharged from aquaculture ponds during water exchange or at draining for harvest may be enriched with nutrients and suspended and soluble organic matter when compared with receiving water bodies. Organic matter also settles to pond bottoms, and when ponds are drained, sediment particles may be resuspended. Receiving water bodies have the ability to dilute and assimilate the pollutants entering them, and if that capacity is not exceeded, the discharges from aquaculture farms will not cause eutrophication. When discharged into large bodies of water, pollutants from ponds will be diluted, and currents will carry them offshore or downstream. At the same time pollutants are being diluted and transported away from aquaculture sites, they are being assimilated and rendered harmless. Therefore, to prevent pollution, site selection and infrastructure design should be done with consideration for efficient effluent disposal and prevention of eutrophication. When eutrophication occurs, water available for use in aquaculture farms will be negatively impacted because many water bodies are both the water supply and the effluent recipient for aquaculture farms. Methods to reduce the pollution potentials of outflows from aquaculture farms are essential both to diminish eutrophication of receiving waters and to protect the water supply of aquatic farms.

A number of techniques are now employed to reduce the concentrations of nutrients, organic matter, and suspended solids in aquaculture farm waters. These include improvements in feed quality that enhance digestibility and reduce nitrogen and phosphorus contents. Small quantities of feed placed on strategically-located underwater trays in ponds (feeding trays) or demand feeders allow farmers to determine how much feed aquatic animals will eat on a particular day to prevent overfeeding. Better aeration methods help maintain dissolved oxygen concentrations throughout the pond volume and in surface layers of bottom soils to enhance the assimilative capacities of ponds and reduce the pollution load in discharges. Better feeding methods and aeration technology also have reduced the need to exchange large volumes of water in coastal ponds with the result that less waste is discharged from ponds than in the past. Today, most shrimp farmers exchange no more than 2 to 3% of pond volumes per day, and some farmers use static water systems or water-recirculating systems that do not employ water exchange. Water is released mainly after heavy rains or when the ponds are drained for harvest. By holding water in ponds longer, more of the potential pollutants can be assimilated within ponds instead of being released to the outside. However, for this system to be effective, shrimp ponds should not be stocked with more than 30 or 40 animals per square meter.

In channel catfish farming in the United States, fish are harvested from ponds with seines and ponds are not drained for harvest. It might eventually be possible to develop such techniques for shrimp farming and other types of coastal aquaculture.

Government regulations, discharge permits, and water quality standards could set criteria for maximum limits and ranges for effluent quality. However, it is probably more practical in tropical nations for the shrimp farmers to adopt codes of practice with best management procedures that provide environmental protection without need for intensive monitoring programs for effluents. Such techniques have been used successfully in agriculture in the United States, and they afford both environmental protection and improved efficiency of production.

## Sedimentation in natural water bodies

During pond construction there is potential for soil erosion because of soil exposure to rain and wind action. The risk of erosion can be reduced if construction is taking place during the dry season. Precise cut and fill calculations prevent any excess soil material from being scraped and disposed of in spoil piles. Good compaction of pond levees and canals are necessary, as well as constructing embankment slopes that will prevent erosion from runoff. Canals should be designed so that water currents will not reach a scouring velocity and suspend soil particles through erosion of bottoms and sides of canals. Erosion sensitive sites in canals should be lined to prevent erosion. Embankments should be covered by grass species tolerant to the prevailing environmental conditions at the farm location. During operation of aquaculture farms, proper attention should be given to maintenance of embankments and canals in order to reduce suspended solid concentrations in outflowing water.

Schwartz and Boyd (1994) have shown that 50% of the settleable solids discharged when channel catfish ponds were drained was released in the last 5% of the effluent volume. These findings suggest that the best way to minimize suspended solids in aquaculture pond effluents is to harvest ponds by seining without completely draining them, hold the remaining water for 2 or 3 days to permit sedimentation, and slowly discharge the water. Alternatively, the water can be passed through a settling basin. Mangrove and other wetlands offer a potential option to settling basins for providing removal of nutrients, organic matter, and suspended solids from pond effluents.

The accumulation of organic matter, soil particles, and other sediments in the bottom of ponds is a common phenomenon during the aquaculture production cycle. In Southeast Asia farmers think that the sediment contains excessive amounts of organic matter and often remove the surface 5- to 10-cm layer of sediment from pond bottoms after each crop. Recent research shows that it is not necessary to remove sediment after each crop (Boyd et al. 1994; Munsiri et al. 1996), and the practice is declining in popularity. Where aquatic animals are harvested after completely draining a pond, the pond bottom should be dried (sun baked) for 2 to 3 weeks to increase microbial degradation of accumulated organic matter. Microbial decomposition can be stimulated by tilling the bottom of an empty pond with a disk harrow to encourage soil aeration (Boyd and Pippopinyo 1994). Small amounts of sediment that accumulate in the deeper areas of ponds can be excavated periodically, placed in areas of the ponds that have suffered erosion, and compacted. If larger amounts of sediment must be removed, the excavated material could be applied to specified areas that do not drain into freshwater bodies and that are not in contact with underground aquifers. Special care needs to be taken where such sediments come from brackishwater ponds to avoid salt leaching into freshwater supplies.

### Salinization of freshwater

Seepage through pond bottoms, discharge of pond waters into freshwater areas, and leaching of salt from sediment disposal sites can salinize freshwater. If ponds are built on sites with soils of adequate clay content, seepage will not be a major factor. It is not necessary to discharge pond water into freshwater bodies, and this practice should be prohibited. Aquaculturists are learning that it is seldom necessary to remove sediment from ponds, but when it is necessary, sediment should be disposed in a manner to prevent leachates from entering freshwater.

### Toxic and bioaccumulative chemicals

The most common substances added to aquaculture ponds are fertilizers, liming materials, and feeds. These materials can cause nutrient and organic enrichment, but they are not toxic. Zeolite is widely used in ponds in Asia for ammonia removal. Zeolite is a natural mineral and has no real benefits to pond water quality, but it is not toxic or bioaccumulative. Chlorination is sometimes used to disinfect pond waters and bottom soils suspected of containing disease vectors. The common form of chlorine used in ponds is calcium hypochlorite. It is the same compound widely used to disinfect public water supplies and swimming pools, and it quickly degrades to non-toxic calcium and chloride ions.

Many Asian shrimp farmers use a variety of bactericides, enzyme products, bacterial amendments, and other products in ponds. The benefits of these products to aquaculture are unproven. The products are not popular outside of Asia, and their use is even declining there because benefits are not obvious. Nevertheless, all of these products have been used in other types of agriculture, and they have a history of safe use.

Antibiotics are often used in shrimp farming. They are administrated in the food or applied directly to the water. Overexposure of larvae to antibiotics in hatcheries may result in poor natural resistance and survival in production settings. Excessive use of some antibiotics during the grow-out period could lead to the development of resistant disease organisms (Spanggaard et al. 1993). Persistence of tissue residues in marketable animals sometimes causes them to be rejected in the international market. It was also shown that significant levels of antibiotic-resistant bacteria that are human pathogens can occur in aquaculture ponds where antibiotics are routinely incorporated into animal feeds (Twiddy and Reilley 1995). Antibiotic therapy is often the last line of defense for aquaculturists in attempts to control bacterial infections. However, regular use of antibiotics should be minimized, and serious consideration should be given to alternative methods of disease control.

### Conversion of crop land to aquaculture farms

In some countries, aquaculturists have obtained permission from the government to use land that had formerly been used by other people for home sites, agriculture, gathering of wood for fuel and construction, hunting, fishing, and other purposes. The conversion of the land to aquaculture farms can restrict resources for local users and sometimes force them from the land. Thus, there have been conflicts between aquaculturists and local people. These issues are social issues and cannot be solely addressed by environmental scientists. The decision on how to best use land for the maximum benefit needs to come from a broad consensus, involving aquaculturists, sociologists, environmentalists, representatives of local interests and local activist groups, economists, policy makers, etc.

### Excessive use of resources

Freshwater resources are limited and they should be conserved. Freshwater aquaculture ponds should be operated without water exchange, and they should only be drained every few years for pond repairs and fish inventory adjustment. Instead of draining ponds for harvest, water can also be pumped to adjacent ponds and then reused in the same or other ponds.

In the early days of shrimp farming, it was common practice in Taiwan and some other Asian countries to mix freshwater and brackishwater to provide a salinity in production ponds of 15 ppt. Excessive use of freshwater from wells occasionally caused local land subsidence and salt water intrusion into freshwater aquifers. Shrimp have been successfully cultured over a salinity range from less than 5 ppt to about 40 ppt. Farmers outside Asia seldom use freshwater in ponds, and today, the practice is rare even in Asia.

Aquaculture feeds are made primarily from plant and animal meals, such as soybean meal, rice bran, fish meal, shrimp head meal, squid meal, etc.. Vitamin and mineral supplements and other additives are also added in feeds. Some of these ingredients are by-products from other industries and their use in aquaculture feeds is a wise use of a by-product.

Aquaculture like any other type of agriculture requires inputs of energy and other resources. Wise use of natural resources should be encouraged by sound management, conservation, use of alternative sources of energy, and recycling, but use of natural resources is necessary to meet the needs of the population.

### Negative effects on native fisheries and biodiversity

As already mentioned, mangroves and other wetlands are not good sites for aquaculture farms, and their protection is highly recommended. Eutrophication of water in aquaculture ponds is desirable to achieve good production, but aquaculture effluents may be more concentrated in nutrients and organic matter than many waters into which they are discharged. Discharge of such effluents should be kept to a minimum and effluent quality should be maintained within acceptable ranges for potential pollutants, because eutrophication reduces biodiversity. In coastal aquacultures, when water is pumped into the farm, various animals may be pulled into the pumps and killed. Impingement by pumps should be prevented by the use of intake screens.

Some kinds of aquaculture, mainly shrimp farming, have relied heavily on wild-caught broodstock and larvae to supply animals for stocking. Aquaculturists now prefer to produce or acquire larvae or fingerlings from hatcheries for stocking in production ponds. Hatchery animals can be certified disease-free, or they may be the result of an enhancement program where traits beneficial for growth and disease resistance were selected. If sufficient hatchery capacity is available, it guarantees that aquaculturists can stock ponds at any time desirable and makes production more efficient.

Scientific literature abounds with examples of problems resulting from the introduction of non-native species to certain regions of the world. Strict international regulations should be applied to aquaculture.

## A PROACTIVE APPROACH

A growing number of aquaculturists realize that denial of environmental impacts of aquaculture is not to the benefit of the industry. The industry must face the problem straight on, and cooperate with governmental and non-governmental groups to protect the environment. It is apparent that much better management practices are being adopted in aquaculture and that farmers are more aware of the value of environmental protection than in the past. For example, most recent aquaculture conferences at local, national, and international levels have had sessions dealing with the environment, and several symposia have been convened specifically for aquaculture and the environment.

A number of aquaculture associations are trying to develop environmental guidelines for aquaculture. The Global Aquaculture Alliance, a new multinational consortium of aquaculture producers and marketers, is dedicated to development and promotion of improved practices to enhance the efficiency of aquaculture and to reduce or overcome completely negative environmental impacts. The GAA believes these dual objectives are complementary. The GAA is in the process of developing codes of good practice and will emphasize their implementation in coming months.

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# GREENPEACE ON INDUSTRIAL SHRIMP AQUACULTURE
# - FAST TRACK TO A DEAD END -

by

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## 1. *INTRODUCTION*

The growing concern over the environmental and social impacts of shrimp aquaculture has led to a call for a global moratorium to halt the further establishment or expansion of shrimp farming, and that responsible parties undertake a major study to determine the best means to transform shrimp aquaculture into an activity which is equitable and ecologically compatible with the principles of sustainable development **(Choluteca Declaration 1996 appendixed)**. This call for a moratorium is consistent with the objectives of the Earth Summit's Agenda 21, Chapter 17 (e.g., 17.22, (a)-(e)), and with many of the principles of the Rio Declaration on Environment and Development, and likewise consistent with relevant Articles in the UN Food and Agriculture Organization's Code of Conduct for Responsible Fisheries.

It is evident that the widespread, consistent pattern of well-documented environmental and social problems caused by the rapid expansion of industrialized shrimp farming in tropical developing countries are incompatible with key principles in the Rio Declaration which, among others, include: development today must not undermine the developmental and environmental needs of present and future generations (Principle 3); in order to achieve sustainable development, environmental protection shall constitute an integral part of the development process, and cannot be considered in isolation from it (Principle 4); nations shall use the precautionary approach to protect the environment, and where there are threats of serious or irreversible damage, scientific uncertainty shall not be used to postpone cost-effective measures to prevent environmental degradation (Principle 15).

These basic principles have been given more substance in relation to aquaculture in The Code of Conduct for Responsible Fisheries, unanimously adopted by the Twenty-eighth session of the FAO Conference in October 1995. The Code's Article 9 contains provisions, particularly in section 1, that give the mandate to States to take action to put an end to the environmental and social problems generated by industrial shrimp aquaculture. Article 9.1.4: *"States should ensure that the livelihoods of local communities, and their access to fishing grounds, are not negatively affected by aquaculture developments".* Article 9.1.5: *"States should.. undertake...environmental assessment and monitoring with the aim of minimizing adverse ecological changes and related economic and social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemical, and other aquaculture activities."* Articles 9.3 and 9.4 go into detail on specific measures regarding the use of alien and genetically altered species, chemical inputs (fertilizers, antibiotics, etc), broodstock, larvae and fry, and the disposal of wastes.

Additionally, other Articles in the Code of Conduct are relevant to aspects of the social impacts of industrial shrimp aquaculture. Articles 10.1.2 and 10.1.3 call on states to involve coastal communities in decision making and to take into account the *"rights"* and *"customary practices"* of coastal fishing communities. Article 6.18 calls on States to *"protect the rights of fishers... particularly those engaged in subsistence, small-scale and artisanal fisheries, to a secure and just livelihood, as well as...preferential access to traditional fishing grounds".*

The Code of Conduct's Article 11.2.15 calls on states, multilateral development banks, international agencies and other relevant institutions (e.g. NACA) to ensure no environmental damage or negative impacts on food security as a result of export production and international trade. Article 6.8 calls on States to protect and rehabilitate all critical habitats, including *"wetlands, mangroves...nursery and spawning areas".* Article 7.6.10 calls on States to *"make every effort to ensure that...habitats...which have been adversely affected by fishing or other human activities are restored".* All of this language in the Code has been agreed by all FAO member nations ("adopted" by consensus on 31 October 1995 at the 28th session of the FAO Conference in Rome), including those agencies invited to attend the Consultation.

Using the language in these Articles as a standard, it can be seen that the shrimp aquaculture industry, as it has operated in the past and continues to operate today, is a long way from compliance with these Articles, and this stands as a powerful indictment of the failure of governments, MDBs, international agencies and relevant institutions.

Greenpeace contends that the above referenced Articles in the Code of Conduct, particularly Article 9.1.5, form a solid basis for the 1996 Choluteca Declaration demand for a moratorium on further expansion and a full review of the environmental and social impacts. This paper presents the case that under current modes of operation, industrial shrimp aquaculture is inherently unsustainable because of its harmful environmental impacts on coastal marine habitats and on marine biodiversity, some which might be irreversible, and because it has the potential to undermine the food security and quality of life of people in coastal communities who are being adversely effected by such development. Because there is substantial uncertainty surrounding the issue of the long term environmental effects and sustainability, and because proponents of shrimp aquaculture have not proven that its synergistic and cumulative effects on the environment will not be detrimental (particularly in the sense of reversibility), the principle of precautionary action demands that responsible governments move immediately to halt its spread, and take corrective action (e.g. restoration of mangroves and other wetlands) in cases where environmental damage has occurred. In this instance, Principle 16 of the Rio Declaration, invoking the *"polluter pays"* principle and *"internalization"* of environmental costs is relevant. This paper proposes four principles for developing sustainable aquaculture generally, and some policy considerations to avoid negative impacts of shrimp aquaculture particularly. The paper also proposes international cooperation between shrimp producing and consuming countries aimed at establishing enforceable international standards dealing with the shrimp industry's environmental and social externalities, needed because the industry is intrinsically incapable of self-regulation.

## *2. BACKGROUND*

In emphasizing the importance of fish and other forms of seafood to the maintenance of global food security, the UN Food and Agriculture Organization (FAO) has highlighted the fact that capture fisheries have reached a production "plateau" of fish for direct human consumption with a consequent decline in average annual per capita supplies. Against the backdrop of the urgent need to substantially reduce the overcapacity in the capture fishery sector, FAO's warning that the demand for fish for direct human consumption is likely to grow faster than the sector will be able to supply in coming years poses a serious global food security dilemma. FAO has made it clear that *"unless the appropriate actions are taken very soon, the contribution of fisheries to food security – and to economic welfare generally – will decline".* **(FAO KC/FI/95/1).** The implications of this trend are likely to be felt most severely in the developing countries as a whole, where fish currently makes up about one-fifth of the total animal protein consumption. Aquaculture is heralded as the means of bridging the projected shortfall in fish supplies for human consumption with the claim that it offers significant potential in many countries, as an agent for economic development and in the provision of food for lower income groups in developing coastal countries.

Some forms of aquaculture production have such potential, with the proper environmental safeguards in place and in the appropriate social and cultural conditions. Unfortunately, the large-scale monoculturing of shrimp for luxury export markets has been seen by the governments concerned as an economic growth factor, stimulating trade and the influx of foreign currency. The development of capital- and resource-intensive shrimp aquaculture in the coastal zone is unsustainable for several fundamental reasons: the purpose is misguided; foreign markets are often favored over domestic needs; facilities are often established or taken over by non-local interests; the choice of species, the siting and design of facilities, and the methodologies do not take ecological and social impacts into consideration; and the regulatory frameworks, where they are in place, are not adequately protective of coastal environments and coastal societies for a variety of reasons.

As the intensity of operations and the density of shrimp farms has exploded along tropical coastlines, there has been: severe degradation and pollution of coastal ecosystems with serious biodiversity implications and the consequent loss of associated goods and services provided to traditional coastal communities; soil and water salinization; the abuse of chemicals; over-exploitation of wild stocks of marine fish and destruction of natural shrimp seed resources; wild stocks of marine species, and now even the cultured shrimp stocks themselves, are declining, and in some cases collapsing, as a result of habitat loss, pollution and diseases.

In its 1995 review of the State of world aquaculture, FAO characterized some of the problems associated with the rapid rise of shrimp farming:

*"The inexorable global expansion of marine shrimp farming generated by market demand, short-term gain and government support because of export earnings has brought with it super-intensive systems, nomadic farmers, environmental and sociological disputes. water quality and disease problems and crashes in the production of some countries."* **(FAO Aquaculture 1995 p.12).**

FAO has also stated that the degradation of aquatic environments in coastal and catchment areas, and increasing competition between the fisheries sector, the aquaculture sector, and other sectors for resources, such as space and water, emphasize the need for a comprehensive and integrated approach to the management of these areas through national policies built on cross-sectoral approaches to their management **(FAO KC/FI/95/1 p.v.).**

Ironically, just at the moment in history when a reliable source of food from the sea is needed to augment the food supply from overtaxed agricultural lands and declining capture fisheries to help feed expanding populations, coastal marine ecosystems are severely stressed with some on the verge of collapsing. While this is not attributable solely to the uncontrolled spread of industrial shrimp farming, the rate at which this industrialized, intensified model of aquaculture, epitomized by shrimp farming, has spread throughout tropical coastal ecosystems and degraded the environment thus far, and the rate at which it is projected to expand worldwide, underscores the urgent need for precautionary action by responsible nations to avoid any further damage. Guided by the profit motive exclusively, shrimp aquaculture development has degraded coastal ecosystems and communities. Yet these are false profits based on false assumptions and improper accounting. The natural resources used are not valued or paid for and therefore do not show up as costs, and the long term costs in degraded or lost natural resources and social disruption are not included. Coastal areas are much too important to human life and to the health of marine and terrestrial ecosystems globally to permit their development for purposes that do not contribute to the maintenance of healthy coastal environments, biodiversity and human communities. This was affirmed by nations at the Rio Earth Summit and Agenda 21.

## *3. THE SPECTACULAR BUT UNSUSTAINABLE GROWTH OF SHRIMP AQUACULTURE*

The contribution of shrimp aquaculture to global shrimp production rose from six percent (6%) in 1970 to about 26% by 1990 (in 1995 about 712,000 tons of shrimp were produced by shrimp farms out of a total global production of roughly 2.6 million tons). In terms of value, there was a 16-fold increase from US$300 million in 1980 to $7 billion worth of cultured shrimp by 1993 **(Rosenberry, 1993)**. Shrimp aquaculture industry observer, Bob Rosenberry notes that: *"from 1975 to 1985, the production of farmed shrimp increased 300%; from 1985 to 1995, 250%. If it were to increase by 200% in the next decade, production would be 2.1 million metric tons in 2005."*

The stunning growth over two decades, and now predictions of doubling farmed shrimp output within the next, is driven by an expansionary dream jointly held by the various actors participating in the global shrimp trade, typified by the words of I.C. Liao of the Taiwan (Province of China) Fisheries Research Institute: *"The real challenge to the prawn culture industry is to succeed in what animal husbandry has achieved with the chicken - that is, to make this luxury and gourmet food, prawn, an everyday-food item. Someday, when the ordinary man-on-the-street can come home any night and dine on a dish of clean, uncontaminated, nutritious and tasty prawn, and enjoy his gourmet meal like kings used to do in their royal palaces, then the world's prawn culture industries will have reached the summit of their achievement." **(Liao 1990)**.*

The global shrimp aquaculture production and trading industry operates in a highly competitive world market, in which numerous influential actors with varying agendas, are vying to steer its course to the future. The increasing regional and national competition arising from the large and increasing influx of investment into the shrimp aquaculture industry – from Asia to Latin America and now into Africa -- should be cause for great concern. In an industry struggling to cope with even the most fundamental challenges such as the need to control production and prices, in which production is partly dependent on the decisions of numerous producers, and freedom of entry by new producers is not prohibitively expensive, the effective self-regulation of production by the industry is practically an impossible task **(Barraclough & Finger-Stich 1995. p.36)**. It is also an industry which to date has failed to internalize the environmental and social costs of its activities and it is indeed doubtful whether these costs could ever be effectively internalized in a way that it can be economically sustainable in realizing the vision of shrimp as an "everyday food item" as proposed by Mr. I.C. Liao.

*(1)* Barriers to entry in the shrimp aquaculture industry are virtually non-existent. Even the start-up capital and technological requirements pose no real deterrents, especially to the financially well-endowed, diverse group of investors attracted to the industry, many of whom are completely new. Production costs to the farmer represent only a fraction of the real cost of shrimp production. Such costs only reflect the private cost accounting of the farm or firm. As Kee-Chai Chong has described it: *"The social and environmental costs of both pecuniary and non pecuniary externalities arising from shrimp farming, including even shrimp trawling, have not been entered and accounted for in the ledgers of farm or firm. Costs of impairment, degradation and destruction to the ecosystem and environment are frequently irreparable. Extensive conversion of valuable mangroves and other wetlands and prime as well as marginal land like rice fields, coconut and sugar plantations into shrimp ponds; pollution from pond, hatchery, feed mill, cold storage and processing plant effluence; outbreak and spread of disease organisms and development of undesirable resistance or immunity of such organisms to treatment due to indiscriminate use of*

> *antibiotics discharged into the open waters; irreversible drawdown on valuable ground water resources are just some of these unaccounted social and environmental costs. Those costs do not appear in the ledger of the shrimp businesses where only private costs are considered."* **(Kee-Chai Chong 1990).**

The forecast of substantially increased farmed shrimp output will invariably lead to lower shrimp prices, cutting into the profit margins of shrimp farm operators. And if profit margins to the farmed shrimp industry diminish, cost-cutting will become more important to profit conscious investors, resulting very probably in even greater desire to deflect any additional costs, such as the internalization of environmental and social costs not presently accounted. Attempts to force shrimp farmers and firms along such pathways by governments to require at least some of the unaccounted social and environmental costs to be internalized will be met by strong resistance. And increasingly, as the sector becomes more concentrated into the hands of fewer, but more powerful and predominantly corporate entities, the field of action and ability of developing nations' governments to impose such requirements will be greatly reduced.

Given that it is the intention of the industry to greatly expand and perhaps even double output of farmed shrimp within a decade, and with what is currently known about the nature and extent of the destructive impacts of the process to date, there is sound justification for concerns being expressed over the ecological sustainability of export-oriented shrimp aquaculture as a sector, and its potential impacts on food-security in developing coastal countries. If appropriate forms of coastal and marine aquaculture are to contribute to the nutritional and livelihood needs of lower income groups in developing coastal countries, then the approach of monoculture production systems of shrimp and other luxury export-oriented products that dominate entire coastal regions must be abandoned.

## *4. THE ECOLOGICAL IMPACTS OF SHRIMP FARMING*

While it is not the purpose of this paper to elaborate on ecological impacts, as that has been extensively reported in a vast array of literature on the subject over the last 15 years, a summary of what is known is useful. Shrimp aquaculture can produce a bewildering array of known and possible environmental impacts. These are mediated by the type of production, size of operation, amount of farms within a region, siting, and management practices. There is little information on the long-term environmental effects of intensive and semi-intensive shrimp aquaculture, often because many systems have only just been recently developed -- either as a new enterprise or as a result of conversion from an extensive pond system. Further, little is understood about the long-term effects that might result from cumulative processes (e.g. incremental losses of habitat and species, accumulation of salt in soils and aquifers, repeated doses of environmental pollutants, or indirect effects such as 'biomass' fishing for feedstock/aquafeed). This, in conjunction with the general paucity of environmental research on the effects of shrimp farming, strongly suggest that their ultimate impacts are far from known. This is further made evident by Eong **(1993)** who suggests that the conversion of mangroves to aquaculture ponds ultimately releases substantial amounts of carbon into the atmosphere. Regardless, studies that have been done, notably in the Philippines and Taiwan (Province of China), and information derived from studies on non-shrimp aquaculture show that impacts are, and will continue to be, profound.

Aquaculture generally can have significant impacts on coastal environments, unless specific measures are adopted to mitigate them. Any improper development of coastal aquaculture leads to significant destruction of fragile coastal wetlands and ecosystems with negative impacts on flora and fauna, and human communities that have traditionally lived in these areas. The damaging ecological impacts of the more intensive forms of aquaculture operations associated with shrimp farming on natural ecosystems arise through:

(1) physical destruction of important habitats, including mangroves and wetlands, in the process of constructing aquaculture ponds (this can be true of extensive forms of shrimp aquaculture too);

(2) the discharge of waste and pollution created in shrimp production created through the intensive application of feeds, fertilizers, and other chemicals. This chemical soup pollutes the surrounding environment in various ways, and can also cause severe eutrophication and hypernutrification of local waters; the draining of brackish wastewater from ponds is also responsible for the salination of surrounding environment, e.g. agricultural land and adjacent freshwater reservoirs and/or groundwater supplies;

(3) extraction of large quantities of freshwater from underground supplies which can result in damaging hydrological impacts, such as major land subsidence, and can compound the problem of salination of freshwater aquifers near the coast:

(4) reductions and genetic changes in wild populations of the cultured species;

(5) introduction of exotic species in the environment;

(6) contamination of the surrounding environment by disease and/or pharmaceuticals introduced into the production cycle (e.g., dissemination of antibiotics in medicated feeds) to fight them; and

(7) predator control (deliberate culls of predators and introduction of chemicals to control predators and pests)

These major, specific impacts underscore the wide range of difficulties faced by the shrimp aquaculture industry in coming to terms with the issue of sustainability, especially in coastal regions where shrimp farms dominate the landscape. Usually commercial aquaculture, in the case of shrimp for example, is practiced as large monocultures. Like all types of monocultures, large scale and especially intensive aquaculture will inevitably result in negative environmental impacts, such as wetlands destruction, eutrophication, oxygen depletion, and pollution of the surrounding waters, and make these less suitable or even unusable for other purposes including further culturing and harvesting of natural stocks **(Braaten et al 1988, Folke and Kautsky 1989).**

This is a common feature of all economic activities which concentrate resources that have been collected over vast areas and which use them in a linear fashion without managing the feed-backs with the environment. Failure to recognize the problems associated with this concentration of resources leads to the kind of waste and pollution problems we have seen associated with shrimp aquaculture, which only in the short term and only to some extent can be reduced by the selection of sites with a good water exchange, by changing feeding practices and so on **(Folke 1988, Folke and Kautsky 1989, 1991, 1992).** Looking at the bigger picture, the shrimp aquaculture industry faces two overarching, fundamental issues that will need to be resolved if it is to successfully deal with the sustainability challenge. These have been characterized as the "ecological footprint" of aquaculture and the "fishmeal trap"

### *4.1 Farmed Shrimp's Ecological Footprint:*

The ecological impacts of industrialized shrimp aquaculture can extend far beyond the boundaries of the physical site itself. While the intensified production systems are far more productive they are far more costly to operate and risk prone due to high stock densities, heavy feeding rates, and the difficulty of maintaining adequate water quality and disease control. Environmental impacts are vastly greater and more pervasive in comparison to low density operations.

The additional ecological or biophysical "costs" associated with certain aquaculture production systems has become known as the "ecological footprint". This "ecological footprint" concept seeks to quantify the minimum areas of productive ecosystem required to sustain resource inputs to and assimilate waste outputs from the aquaculture system in question. The results of a study of a semi-intensive shrimp culture system analyzed in Columbia, for instance, revealed that every "farmed" hectare (producing about 4000 kg of shrimp/ha/year) appropriated the productive or assimilative capacity of between 38 and 189 hectares of ecosystem per year **(Larsson, et.al. 1994).**

Larsson and his colleagues estimated that the Columbian semi-intensive shrimp farm appropriated approximately 295 joules of ecological work (i.e. natural inputs such as fish meal, agricultural products in feed and pond productivity plus industrial energy such as labor, energy to catch and produce feed, fuel, fertilizer, maintenance and harvest costs, etc.) in order to produce one Joule of edible shrimp protein. In looking at industrial energy requirements alone (not including labor), shrimp aquaculture ranks high in comparison with other production systems: (Table 1)

**Table 1**

| ***Production system*** | ***Industrial energy input required to produce one joule of edible protein*** |
|---|---|
| vegetable crops | 2 - 4 |
| mussel culture | 10 |
| sheep farming | 10 |
| cod fisheries | 20 |
| chicken farm | 22 |
| Atlantic salmon fishery | 29 |
| semi-intensive shrimp aquaculture | 40 |
| lobster fisheries | 192 |
| shrimp fisheries | 3 - 198 |

Source: Larsson et al

As previously stated, the true costs of the ecological impacts caused by industrialized modes of shrimp aquaculture are not calculated or paid for. Indeed, if such costs of damage to the ecosytem were required to be paid, the intensive shrimp farming industry would be out of business. In their report to the Supreme Court of India, the National Environmental Engineering Research Institute **(NEERI, 1995, Cited in Shiva & Kirir, p. 88)** stated that in Andhra Pradesh the industry brings in 15 billion Indian Rupees (Rs), however the loss due to poor environment conditions caused by it is, Rs. 63 billion. In Tamil Nadu, the damages totaled Rs. 422 crore with the earnings only at Rs. 280 crores. That is, for every one rupeee gained by the shrimp farming industry in these two Indian states, as many as four are lost by the community. **(Shiva & Kirir, p88).**

### *4.2 The Fishmeal Trap:*

Another aspect of the ecological footprint that has implications for both global fisheries and food security is the carnivorous nature of some of the prime commercial aquaculture species, e.g. shrimp and salmon, being produced by aquaculture. Semi-intensive and intensive shrimp culture rely in varying degrees on formulated diets. Fishery products generally make up 70% by weight of compound aquafeeds for most farmed carnivorous finfish and about 50% of marine shrimp **(FAO Aquaculture 1995, p.22).** Fishmeal, together with fish oil, shrimp meal and squid meal have become major ingredients of industrially produced aquafeeds since they mimic the composition of the natural food of carnivorous fish and are the simplest and most straightforward way of providing the nutritional requirements of the high value species **(FAO 1995 p32).** Shrimp aquafeed use will mean increasing competition for fisheries resources, notably in the form of fishmeal. It has been estimated that 20-25 percent of fishmeal production by the year 2000 will be destined for aquafeeds for use in all types of aquaculture production, creating a "fish meal trap." Projections for the expected increase in marine shrimp feed demands in Asia alone by the turn of the century indicate a potential demand of some 776,000 tons, and perhaps as high as one million tons, up from about 480,000 t in 1990 **(New and Wijkstrom 1990)** while global fishmeal production as a whole is expected to be around 6.5 million tonnes by that time **(Primavera 1993).**

Assuming that the intensively cultured, carnivorous fish and crustaceans will depend substantially on fishmeal-based diets, it is probable that the expansion of this form of aquaculture will result in increased fishing pressure, particularly in certain regions near large areas of shrimp farming, as demand for fishmeal increases This gives rise to considerable concern regarding trends in 'biomass fishing' in Asia which involves highly non-selective fishery techniques (involving small mesh sizes) for the single purpose of catching as many marine organisms as possible; after the valued commercial component of the catch is removed, the remaining majority – or "trash" -- is rendered into fishmeal.

FAO has highlighted concerns about these trends: *"Clearly if aquaculture is to be sustainable in the long term and play a significant role in food security, it is imperative that donors, development agencies and governments, wherever possible and economically feasible, promote the culture of species with herbivorous and/or omnivorous feeding habit, which are not dependent upon the use of high-quality protein-rich feed inputs, and which are able to make maximum benefit from natural food organisms and farm-made supplementary inputs".* **(Tacon 1994, cited in FAO Aquaculture 1995).**

The dependence on marine fish catches makes it difficult to believe those who claim that yields from a rapidly growing aquaculture industry which is dominated by intensive cultivation of single-species, will replace the decline in fisheries harvest. On the contrary, exploitation of wild fish to support the monoculturing of shrimp, salmon and other carnivorous species with nutrients may further reduce commercially important fish stocks on which conventional fisheries are based, and there may be a risk that fish now used for human consumption will be exploited for fishmeal production **(Folke & Kautsky, 1996).**

## *5. CONSEQUENCES FOR FOOD & SOCIAL SECURITY*

The scale and extent of environmental damage and social disruption caused by the rapid growth of shrimp aquaculture in coastal areas of developing tropical countries threatens the potential to meet local fish nutritional needs. Where aquaculture is driven by foreign market earning potential, the decrease in fish products going to the domestic market can cause local hardship **(Pomeroy, 1991).** Shrimp aquaculture competes for space and resources with other forms of aquaculture that might otherwise offer social and nutritional benefits, and its propensity to degrade and pollute coastal habitats can be a significant factor in capture fisheries declines. The loss of habitat through mangrove destruction, for instance, will further compound stock recruitment and production **(Paw and Chua 1991, p.203).**

Fishing communities, themselves amongst the poorest workers in the world, and the least well-nourished, are among those hard hit by the explosion of shrimp farming in their regions, particularly when coastal wetlands such as the mangroves are cleared away to set up pollution-generating shrimp ponds. Conversion of mangrove into shrimp ponds has a negative impact on capture fisheries, and as coastal fishers throughout Asia and Latin America depend on numerous species of fish and shrimp that spend at least part of their lifecycles in mangrove areas, the conversion of mangrove thus threatens the viability of the resource base of coastal fishing communities.

The disturbing trend to 'biomass fishing' which is occurring, particularly in Asia, because of the rise in shrimp farming contributes to the already unsustainable fishing pressure that is pushing many fisheries in the developing coastal countries into quite serious declines. This in turn threatens to undermine the food security of millions of coastal people who rely on fish as the main source of protein and other vital nutrients in their diets. The increasing use of aquafeeds made from fishmeal will mean increasing competition for fish that might otherwise be used to provide food for direct human consumption.

In appropriating and replacing traditional farm lands (e.g. for rice cultivation) and mangrove areas, shrimp farms displace affordable locally-produced foods and other valuable products with an export crop (shrimp) that no indigent rural people can afford or even desire. Outside investors are enriched, at the expense of local people's needs. "Development" runs above their heads, while very little "trickles down".

This situation is contrasted with traditional, extensive production of aquatic organisms, including inland and freshwater aquaculture, as a beneficial form of aquaculture, both socially and environmentally -- one that has the potential to contribute substantially to food security, particularly in the case of the rural poor. Unfortunately, shrimp culture has been such a priority in government planning and international development assistance that it has become a massive diversion of money and other resources that might otherwise benefit traditional forms of brackishwater, inland and freshwater fish culture for local markets **(Bailey 1992).** Though the need to address malnutrition and rural poverty is recognized as a serious problem, these are often treated as secondary to the problem of increasing foreign exchange earnings. As a consequence, the benefits of development in aquaculture are being skewed in much the same way that the benefits of development in agriculture and marine fisheries have been skewed toward economic and political elites who have had the capital and the contacts to enable them to take advantage of the opportunity **(Bailey 1985; Panayotou 1980; Scott 1985; Smith and Pestano-Smith 1985)**. International agencies, particularly, have a role to play in assisting developing nations to establish effective resource management systems and should not be in the business of promoting forms of economic development that are ecologically and socially disruptive, as they have consistently been in the shrimp aquaculture business **(Bailey & Skladany 1991).**

Compounding the food security question is the fact that outside interventions and transfers of technology that come with the expansion of industrialized shrimp aquaculture tend to reproduce the high-capital, low-labor-intensive characteristics of industrialized countries' food systems. This contributes to an increase in the cost of food locally, and places food beyond the reach of poorer consumers and contributes to eliminating peasants who cannot compete in wholly mercantilized food systems. The marginalized, displaced rural poor are forced to migrate into large urban areas in search of paid employment, or (in the case of coastal countries) to the coastlines, in search of food and jobs (putting greater pressure, for instance on traditional, open access fisheries) **(George 1990)**.

One of the principal arguments for export-oriented production of high-value commodities such as shrimp is that the benefits of increased foreign exchange earnings will 'trickle down' to benefit local people, creating more jobs, higher wages, and providing access to greater varieties of cheaper staple foods made available through import substitution. As the importance of developing countries in international trade of fish and fishery products continues to rise, the question of whether, and or how many, benefits actually 'trickle-down' becomes more poignant. Countries whose 'export-led' agricultural strategies cause them to emphasize the supply of foreign markets, and to forsake the local peoples' attempts to produce food for local consumption, grow increasingly dependent on massive imported food substitutes, particularly grains, tying them both economically and politically to privileged suppliers **(George 1990)**.

FAO has recently highlighted the fact that at a world level the apparent annual consumption of fish per person was lower in 1993 than in 1989. In a report titled "The Role of Fisheries in Food Security", FAO states (paragraph 34): *"The growing shortage of fish is resulting in increasing real prices. The consequences, which are particularly worrying for "low-income food-deficit countries" (LIFDCs) are two: traders will have a continued incentive to export high-value products to richer markets, and, domestic price levels will rise; both consequences having a negative impact on food security."* **(FAO/COFI 1995)**.

The FAO report proposes that LIFDCs should *"maintain or increase per caput supplies of fish"* by *"ensuring larger supplies of fish and limiting outside demand for fish...in communities where fish is nutritionally important"* in order to *"make certain that at least part of food fish supplies are reserved for those whose food security is compromised."* The report recommends that governments of LIFDCs could accomplish this by taking action to "subsidize production and hinder exports". However, the report states that this type of government action is contrary to the economic policies being introduced in LIFDCs designed to establish market economies, restrict the intervention of government in the private sector, balance national budgets, and stimulate international trade. The report concludes the discussion of this issue on a pessimistic note by stating: *"Thus, in the near future administrators in LIFDCs are left with few means to ensure either larger supplies of fish, or, access by the poor to cheap fish"* (paragraphs 38-41).

In relation to shrimp aquaculture, FAO's conclusions are substantially supported in a 1991 analysis of shrimp aquaculture in Ecuador, done by Howard Odum and Jan Arding **(Odum and Arding 1991).** Their findings reveal that, in the absence of any public policy on managing environmental resources for the public good, the free market economy causes the mangroves and shrimp previously supporting the public generally, to be brought into private shrimp businesses, the products going overseas with much less real wealth returning in the small, and largely concentrated, buying power of the foreign currencies received in return. Odum and Arding demonstrate that in the rush to develop shrimp aquaculture, contributions of coastal environmental systems end up being diminished, and the pattern of selling a valuable raw product abroad produces a very large drain from the developing country. *"If the pelagic fish, mangrove, river...and shrimp products were utilized within Ecuador, prices would drop, standards of living rise, inflation decrease and more buying power would remain in Ecuador."*

Odum and Arding show that continuing pond development so as to maximize profit to the shrimp operators means that the regional economy suffers. Their simulation models showed maximum benefit to Ecuador occurs with less area developed in shrimp ponds than that which maximizes shrimp pond profits. Their recommendations include decreasing the intensity of shrimp pond operations in Ecuador, which may lower yield but will reduce costs; making shrimp more available for local consumption at lower prices; mangrove restoration and converting many shrimp ponds to fish farming to meet local needs and using captured pelagic fish which is being reduced to fishmeal to meet local food needs instead, thus contributing more to the standard of living of local people than feeding shrimp to profit foreign markets.

Complimenting this, a study of the agricultural sector of 65 Third World countries by Marió and Bello presents some parallel perspective in terms of the 'trickle down' question. The study revealed that the increased foreign exchange earnings from increased agricultural exports generally have not been translated into better salaries for workers or into higher investment and growth of the staple food sector **(Marió and Bello)**. This appears to result from the phenomenon of 'disarticulated growth' which is defined by the lack of relationships between the growth of production on the one hand (e.g., of intensive shrimp farming), and consumption functions of the economy on the other, as well as weak linkages between economic sectors generally. Mario's and Bello's data on the impact of disarticulation on food consumption supports a preliminary hypothesis, at least, that higher levels of disarticulation appear to be associated with decreasing levels of food consumption.

## *6. THE ROLE OF MULTILATERAL DEVELOPMENT ASSISTANCE IN ADVANCING SHRIMP FARMING*

Multi-lateral development banks and bi-lateral development assistance agencies share a substantial portion of the blame for the ecological and social damage that has been generated by the blind rush into shrimp aquaculture in Latin America and Asia – particularly the World Bank and Asian Development Bank (ADB). The overall structure of development and investment in shrimp farming was initially directed by the development banks in cooperation with, national banks, and bilateral aid agencies. These entities, as they did during the boom period of capture fisheries, acted as catalysts for private sector investment which is often "tied" between various intra-governmental actors **(Skadany & Harris 1995).**

It is not known precisely how much the development banks have invested in shrimp aquaculture in tropical countries, since becoming active in the sector in the 1970s when loans were offered to governments of Asia and Latin America for development of shrimp ponds. The World Bank financed development projects in Indonesia, the Philippines, Thailand and Bangladesh. By the 1980s the World Bank had broadened its support to include China, India, Brazil, Columbia and Venezuela. The Bank's involvement in lending to shrimp aquaculture development in Latin America and Asia intensified despite the fact that its officials were fully aware at the time of the severe ecological impacts the sector was having in these regions, particularly in regard to mangrove clearance and pollution issues.

The World Bank participated actively in the launching of the shrimp industry in Asia. In the 1980s, it strongly promoted shrimp ponds in China. The Bank loaned China $300 million for projects along the entire coast. By 1991, the country had developed into Asia's largest producer. But the ponds crashed in June of 1993 when a disease spread over the course of a few nights **(Nixon 1996)**.

Primavera contends that the loss of mangroves in the Philippines and elsewhere has been directly facilitated by international economic assistance. The widespread conversion of mangroves to aquaculture of the late 1950s and 1960s in the Philippines can be traced to an active pond construction program of the Philippines government with US$23.6 million funding from the International Bank for Reconstruction and Development. More recently, the Asian Development Bank allotted US$21.8 million for the development of shrimp hatcheries and ponds in Panay Island under the Aquaculture Development Project **(Primavera 1994)**.

Out of an investment in agriculture and fisheries of US$1.685 billion in 1992 the World Bank allocated US$425 million for shrimp and fish aquaculture development to India **(Mukherjee, 1994).** It is believed that a substantial part of this sum would have been destined for intensification and expansion of shrimp ponds. In India, the Bank has been actively promoting shrimp farming in West Bengal, Orissa and Andrah Pradesh. For instance, its loans help finance development of 13 sites covering a land area of about 6,000 hectares with a net waterspread area of about 3,800 ha **(Barraclough and Finger-Stitch 1995).**

The failure by the World Bank, ADB, and other agencies such as FAO to step in and actively move to brake the process years ago when the severity of shrimp farming related problems were becoming known has contributed to massive coastal habitat degradation, pollution and social upheaval in many areas of Latin America and Asia. The Bank's blinkered approach to the development of the sector continued right into the mid-90s when, while the World Bank funded a study in Thailand in 1994-95 to diagnose the widespread disease problems in the Thai shrimp ponds, it was simultaneously developing a loan proposal for Mexico, to develop semi-intensive and intensive shrimp aquaculture ventures based on the same management models as those in Thailand.

The FAO has been a solid partner in actively promoting shrimp farming in the context of its broader support for expanding aquaculture generally worldwide. FAO is currently providing strong technical support for coastal semi-intensive shrimp aquaculture development in many nations, such as Mexico, where there are three FAO aquaculture offices in the state of Sinaloa alone **(Quatro, et al 1996).**

This is one of the chief reasons why the group of environment and development NGOs that have formally joined forces to oppose the spread of industrial shrimp aquaculture, have highlighted as one of the key demands (Demand 4) in the 1996 Choluteca Declaration: *"Ensure that multilateral development banks, bilateral aid agencies, agencies of international cooperation, the FAO and other relevant national and international organizations and institutions do not finance or promote in any way the development of shrimp aquaculture practices which are not consistent with these demands."* Bilateral and multilateral development assistance agencies must heed the FAO Code of Conduct for Responsible Fisheries Article 11.2.15 which calls on States, multilateral development banks, international agencies and other relevant institutions to ensure no environmental damage or negative impacts on food security as a result of export production and international trade.

## *7. TOWARDS SUSTAINABLE AQUACULTURE*

While much of aquaculture today is all too often harmful to coastal environments and coastal societies, it has the potential to play an important role in curing some of these problems instead of contributing to them. A new template for sustainable coastal aquaculture development is urgently needed. Four basic principles have been recommended that should guide the development of coastal aquaculture in any country or region of the world: precaution; diversification, integration, and localization **(Thorne-Miller 1995)**. Current trends in aquaculture defy all four of these.

### *7.1 The Precautionary Principle*

A review of the literature over the past 15 years provides ample evidence of deep-rooted, potentially irresolvable environmental problems associated with present modes of industrial shrimp aquaculture – particularly the handling (or mishandling) of environmental pollution discharged from shrimp ponds. At best, there is great uncertainty surrounding the issue of the magnitude and extent of ecological impacts, particularly in terms of what the long-term, synergistic and cumulative impacts of shrimp farming pollution might be.

As is true for any activity that poses a potential threat to humans, the environment, and biodiversity, it is necessary to apply the Precautionary Principle to shrimp aquaculture projects. International policy makers have adopted the Precautionary Principle, with the aim to prevent pollution, as a guideline for utilizing the best available scientific information, with due consideration to uncertainties and missing information, to predict the potential for polluting chemicals entering the environment to cause harm. While industry generally usually demands a cause and effect scenario in regard to concerns over the potential impacts of pollution, governments, international regulatory bodies and the scientific community have realized that it is impossible to behave responsibly and protect the environment and human health on that basis. By the time the effects of pollutants are known it is already too late. In applying the precautionary principle, the burden of proof rests with the proponents of the activity to show that no harm will be done to the environment or human health Furthermore, where there is concern that there are threats of serious or irreversible damage, scientific uncertainty shall not be used to postpone measures to prevent environmental degradation (see Table 2).

**Table 2: Precautionary Principle Applied to Shrimp Farming**

| **The Assimilative Capacity Approach** | **The Precautionary Approach** |
|---|---|
| ***Assumptions:*** | ***Assumptions:*** |
| Chemical contamination of the environment by shrimp farms is acceptable up to the point of serious or irreversible harm | Chemical contamination of the environment is to be avoided. |
| The environment has a definable capacity to absorb and assimilate chemical contaminants from shrimp farms without harming the biosphere. | The variety and complexity of the chemical contaminants, and the variety and complexity of biological species and interactions, make it impossible to accurately predict the effects of specific levels of contamination by shrimp farms. |
| Even with scientific uncertainty regarding the effects of pollutants, it is possible, by risk analysis to determine safe and unsafe (or acceptable and unacceptable) levels of particular shrimp farm contaminants entering the environment. | Because of the scientific uncertainties it is not possible to define safe and unsafe levels of shrimp farms' contamination, and acceptable levels derived from incomplete information are not protective. |
| ***Elements:*** | ***Elements:*** |
| Risk analysis of shrimp farming pollution leads to an ability to set acceptable levels and types of input of pollutants. | Prevention of shrimp farm contaminants entering the environment. Use of scientific information to prioritize reduction efforts. |
| Action taken only after proof of damage. | Action taken before damage and before conclusive scientific proof (action based upon potential to cause damage). |
| Burden of proof rests upon those questioning a shrimp farming pollution. | Burden of demonstration rests upon those proposing the activity. |
| Implementation achieved through discharge limits - usually based upon water, air and soil concentrations, not total output. | Implementation through proper design and clean production methods (i.e., eliminating contamination at source). |
| ***Consequences:*** | ***Anticipated consequences:*** |
| After decades of this regulatory approach in coastal areas where industrialized shrimp farms have operated lands, freshwater aquifers, and marine waters are suffering increasing degradation. | Pollution of coastal areas from shrimp farms will be eliminated at the design and production levels. |

All major aquaculture projects must be evaluated as to their potential environmental impacts, through independent environmental (and social) impact assessments. In applying the precautionary approach to the environmental impact assessment process, when there is legitimate cause to expect negative effects on the environment, on local biodiversity, or on local communities, the project should not be undertaken or should be modified to avoid those impacts. The environmental impact assessment process has not been adequately applied to shrimp aquaculture development in most countries thus far, for variety of reasons.

As currently practiced, and given the lack of certain knowledge about the wide-ranging, potentially harmful ecological outcomes that might eventuate in the course of coming years, there is good reason to invoke the strict application of the Precautionary Principle to counter market forces that are hard at work to greatly expand export-oriented shrimp farming over the next 5-10 years. In keeping with the precautionary principle, there is a great need for a moratorium on expansion of the shrimp aquaculture industry until difficult questions can be asked and satisfactorily answered, as demanded in the Choluteca Declaration of 1996.

Industry advocates have failed thus far to provide any proof that the pollution dumped into the environment by industrialized shrimp farming poses no risk or harm to the environment. Most arguments presented by shrimp aquaculture industry advocates to date have been mere conjecture, usually qualified by such statements as: "if conducted properly, shrimp farming is not harmful to the environment". It remains to be demonstrated how industrialized shrimp farming can be "conducted properly" and the overall industry itself remain economically viable in light of the need to internalize unaccounted environmental and social costs on the part of an industry whose a major aim is that of reducing operational costs (in the face of declining profit margins) within an overarching goal of doubling global output within ten years.

### *7.2 The Diversification Principle:*

Just as biological diversity is the key to survival and evolution of life on earth, it is also vital to the sustainability of aquaculture. This principle is applicable at the local level, as well as within countries and across regions. An individual facility is more sustainable if it incorporates a variety of species which are interdependent upon one another (polyculture), which allows the facility to have a diversity of purposes and to adjust to a variety of conditions. For instance, many models for polyculture try to integrate the role of waste water treatment into the culture of marketable species, with a long history of such operations demonstrated in China.

While diversity of species is to be encouraged in individual aquaculture operations, there might be some room for single-species aquaculture if, and only if, diversity of species is achieved on a larger scale (e.g. nationally or regionally). For example, it may be that shrimp culture would be more tolerable environmentally if the number and siting of facilities were severely restricted and if aquaculture development plans provided for a wider variety of species to be cultured throughout the region. The extent to which this is advisable has yet to be demonstrated, however, and the precautionry principle must apply in seeking to determine its environmental sustainability. Development plans should give particular attention to culture species and culture methodologies that would be most consistent with ecological and sociological conditions in various locations.

One factor inhibiting diversification is that full life-cycle culture methodologies are not worked out for many species. Thus much more money has to be put into research on a variety of species. Monocultures often rely heavily on wild seed, and when there is only one species being cultured widely in a region, the toll can be heavy on the wild populations. In the meantime, the culture of species that must be seeded from wild stock might be viable only if special attention is paid to the condition of the wild populations and carrying capacity of the environment, again under a regime wedded to a strict precautionary approach. In contrast, if diversity were the governing principle in aquaculture, wild seed stocks of various species would be required in far smaller quantities. As with any fishery, however, it would be important to monitor the condition of wild populations and to avoid taking non-target species. The population and genetic diversity of wild, warmwater shrimp populations is seriously threatened by wild seed collection practices, and there are critical concerns about impacts on related and dependent species in the affected food webs from the overharvesting of post larvae and juveniles for pond stocking. Aside from the likely declines in shrimp biomass, shrimp pond 'seed' collection from the wild also results in the substantial loss of non-target postlarvae and juveniles. It is estimated that at least 90% of the seed collected is made up of non-preferred shrimp species and/or the postlarvae of fish species and is destroyed. Furthermore, it is estimated that for every individual shrimp seed that is pond-stocked more than 100 other shrimp and fish postlarvae have died in the process **(Fast 1992).** Obviously, an ecosystem approach which addresses the relationships between fisheries and aquaculture is necessary.

In seeking diversification, researchers, planners and investors should keep in mind the need for compatibility with local ecosystems and cultural traditions of rural communities. To diversify requires some experimentation and risk-taking, and governments should provide incentives to focus upon long term benefits rather than short-term profits when developing aquaculture. FAO may be able to provide useful guidelines for accomplishing that goal internationally.

### *7.3 The Integration Principle:*

An holistic approach to aquaculture would include integration with other sectors based upon an ecosystem approach to management. ICLARM's Roger S.V. Pullin has framed the issue succinctly, describing how, in looking for "solutions" to the chronic problems that plague aquaculture's explosive growth, the vast majority of policy makers and developers, agencies, researchers, producers and consumers, ask questions about the future of aquaculture based on a single premise: how can enough farmed fish/shrimp/seafood be produced to fill the gap between supply from stagnating or declining capture fisheries and the increasing demand in developed and developing countries? As he recently pointed out: "… such questions address a limited part of the issues for aquaculture and reveal the very limited progress made so far, in the post-UNCED/Agenda 21 world, towards *intersectoral* perspectives and actions. If production of fish, or indeed of anything, costs 'too much of the earth', then it will ultimately not be sustainable and related policies and consumption and production patterns will have to change sooner or later." **(Pullin 1995).**

Pullin argues that taking a too narrow, or "sector specific" approach *lowers* rather than raises the limits of growth to production of any commodity because: 1) it increases the possibilities of resource use conflict; 2) it misses opportunities for intersectoral synergy; and 3) it increases the likelihood of exhaustion of resources. A more holistic/ecological approach is to acknowledge the importance of identifying and developing what Pullin calls a *sustainable pattern* of aquaculture production.

Aquaculture can be a sustainable activity on a global scale if it can become a pivotal component in the sustainable use of natural resources generally and complements rather than competes with other sectors. Pullin sees aquaculture becoming a routine component of farming and forestry, not only for fish production, but also for the environmental and ecological 'services' provided by farmed fish and the aquatic surroundings; e.g., waste recycling, provision of fertile waters and pond muds, and contributions to pest and disease control. Such benefits can and should be evaluated in monetary terms. Beyond the farm level, integrated systems that include aquaculture can also make contributions to environmental restoration across degraded catchments and coastal areas, by assisting forestry, helping to reestablish vegetation, and improving water management and soil conservation. Unfortunately, none of these possibilities have been adequately researched, largely because humanity's thinking and the investment that flows on from it is dominated by 'the development paradigm' which is oriented around the mass-production, monocultural model, tied into international commodity markets and geared to maximizing short term profits.

In general, the more a cultivation system resembles and fits with the processes and functions of ecosystems the less negative environmental effects can be expected **(Folke and Kautsky 1992).** By introducing parts of food webs in the culture, as is the case in some parts of Asia, ecological complexity is increased **(Yan and Yao 1989, Wang 1990, Zhao 1992).** Such cultures will function more as natural ecosystems, which means that energy subsidies and costs can generally be reduced per unit of production. By creating feed-backs between the culturing and the ecosystem, such as recycling of waste products, environmental effects will be considerably reduced. Such systems have long been used, usually on a relatively small scale, but not inevitably so, to effect agricultural transformations that yield foodstuffs and complementary materials on a sustained basis and with very little environmental repercussion **(Ruddle, 1982).** It has been demonstrated, e.g. in China over centuries, that sustainable food production via aquaculture can be achieved by carefully combining different types of aquatic and terrestrial cultivation systems. In this way it is possible to optimize food production and minimize negative impacts in the area **(Li 1987, Ma and Yan 1989, Liu 1987).**

Ruddle argues that given the inherent fragility of wetlands combined with the scanty and uneven state of scientific knowledge regarding the types of transformations to which they are to be subjected, large-scale schemes that call for radical environmental alterations are best deferred pending better informed planning ability. And, with this in mind, the focus of large-scale development schemes based on monocultures is a mistake. Monocultural systems introduced to wetlands generally prove to be maladaptive, whereas properly designed, integrated polycultural systems of agriculture-aquaculture-livestock are likely to reproduce long-term sustained yields **(Ruddle 1987, pp 195-197).**

### *7.4 The Localization Principle:*

Localization refers to the importance of establishing aquaculture that is designed to meet local needs before looking to larger markets and to be compatible with the local environment even when the crop is destined for distant markets. Some nations, such as China, have to greater or lesser degrees taken such an approach. This means that national aquaculture development plans should identify nutritional needs of local communities, local cultural traditions relevant to land and water use and seafood consumption, species that are compatible with local ecosystems and with local cultural traditions, and the need for environmental protection and clean-up. Generally exotic species should be avoided because of the potential for their release into the local environment..

One goal of coastal aquaculture is to augment local and regional food supplies and to provide alternative occupation for fishers and their families, though this is not always an easy transition, as Polnac **(1991)** has pointed out. Aquaculture is more akin to agriculture than to fishing, and indeed it is often easier to integrate aquaculture with farming than to convert fishers into aquaculturists. Aquaculture development should first address these important local issues. Some priority may also be placed upon wider domestic markets for seafood, but again basic food requirements of poor communities should have precedence over domestic gourmet markets. Kent **(1995)** has recommended steps that need to be taken if aquaculture is to contribute to local nutritional needs. They include: aquaculture projects should do no harm to the food supply, income, or environment of the poor; they should produce low cost products favored by the poor and destined for local consumers; they should encourage community-based production; and governments should monitor food security and related impacts related to the project.

Localized aquaculture may be used to satisfy a need to replenish threatened or endangered marine species. The culture of the queen conch and certain species of grouper (fish) in the Caribbean have been undertaken just for this purpose. When releasing such cultured organisms, however, it is important not to overpower the wild genetic pool and to ensure that no diseases are introduced.

Finally, localized aquaculture may be used to restore degraded coastal ecosystems such as mangroves . In this case, key components of coastal biotic communities are cultured in situ. Ideally, over time, the cultured ecosystem incorporates an increasing variety of species until a natural biodiversity is reached and the normal functions of a healthy ecosystem have been restored. Aquaculture could be important in coastal development in developing countries, but it is crucial that it be done in terms of protecting the ecological functions of the coastal zone, satisfying local or regional food requirements, and improving basic living conditions for rural and urban coastal communities while protecting traditional cultures. Coastal lands and wetlands cannot be turned over to intensive development of monoculture aquaculture in the same way grasslands and forests of the world have been sacrificed to intensive agriculture and forestry.

## *8. NGO DECLARATIONS AS A BASIS FOR MOVING TOWARD SUSTAINABLE AQUACULTURE*

Greenpeace and many other non-governmental organizations (NGOs) from around the world have issued several declarations, amongst them the Statement Concerning Unsustainable Aquaculture to the United Nations Commission on Sustainable Development (May 1996) and the Choluteca Declaration (October 1996). Together they call on governments, and the seafood industry to:

* halt the destruction of mangrove forests, wetlands areas, rivers, lagoons, inlets, bays, estuaries, swamps, marshes, tidelands and other ecologically sensitive coastal areas as a result of aquaculture development;
* ensure that artisanal fisheries and dependant coastal communities, and their access to community resources, are not adversely affected by aquaculture development;
* prohibit the use of toxic compounds in aquaculture operations and the pollution of surrounding areas;
* prohibit the use or salinization of fresh water supplies, including groundwater, important for drinking or agriculture;
* prohibit the use of feeds in aquaculture operations consisting of fish that could be used as food for people;
* prohibit the wholesale conversion of agricultural or cultivable land to aquaculture use;
* ensure that abandoned or degraded aquaculture sites are ecologically rehabilitated and that the industry responsible bear the cost of rehabilitation;
* ensure the development of aquaculture in a manner which is socially equitable and ecologically sound;
* ensure that multi-lateral development banks, bilateral aid agencies, the UN Food and Agriculture; Organization and other organizations or institutions do not fund or otherwise promote aquaculture development inconsistent with the above criteria.

The Choluteca Declaration further calls for a **Global Moratorium on further expansion of the shrimp aquaculture industry** and an immediate **halt to human rights abuses** associated with the industry. The Choluteca Declaration and the Statement Concerning Unsustainable Aquaculture to the United Nations CSD are appendixed at the end of this paper.

## *9. MOVING FORWARD ON POLICIES FOR SUSTAINABLE AQUACULTURE*

### *9.1 Getting in step with the Rio Declaration:*

The Rio Declaration on environment and development contains 27 principles for redirecting the behavior of the world economy towards a “sustainable path”. The Rio Declaration called for the reduction and elimination of unsustainable patterns of production and consumption, and advocated that national authorities promote the internalization of environmental costs and the use of economic instruments, taking into account that the polluter should, in principle, bear the cost of pollution. At Rio, States committed themselves to the sustainable use of coastal areas and to protection of the marine environment under their national jurisdiction. Chapter 17(5) of Agenda-21 highlighted several of key objectives that States should adopt to achieve these aims; among them were three of particular relevance to industrial shrimp aquaculture:

(d) Apply preventive and precautionary approaches in project planning and implementation, including prior assessment and systematic observation of the impacts of major projects;
(e) Promote the development and application of methods, such as national resource and environmental accounting, that reflect changes in value resulting from uses of coastal and marine areas, including pollution, marine erosion, loss of resources and habitat destruction;
(f) Provide access, as far as possible, for concerned individuals, groups and organisations to relevant information and opportunities for consultation and participation in planning and decision-making at appropriate levels.

Governments reponsible for the development of industrialized shrimp aquaculture everywhere it has occurred have completely ignored these key principles.

### *9.2 Governments must act on Choluteca Declaration demands:*

In regard to aquaculture these key measures are backed by relevant Articles in the Code of Conduct for Responsible Fisheries (described previously), and also form the basis for demands found in the 1996 Choluteca Declaration on Unsustainable Shrimp Aquaculture **(Choluteca Declaration 1996)**, which are now being advocated worldwide by the recently formed Industrial Shrimp Action Network **(ISA Net 1997)**. The Choluteca Declaration's demand for a global moratorium (presented above) to halt the further establishment or expansion of shrimp farming is backed by a call for "responsible parties" to undertake a study to determine the best means to transform shrimp aquaculture into an activity which is equitable and ecologically compatible with the principles of sustainable development. During the moratorium, a period of transition or conversion from the use of destructive technologies or practices to more responsible practices should be initiated to ensure the long term survival and health of ecosystems and the viability of a variety of sustainable human activities dependent on those systems. The Choluteca Declaration also called for the formation of an independent body of national, regional and international organizations, including non-governmental organizations, to monitor the implementation of this process at the global level. These demands are entirely consistent with the measures contained Agenda 21, and in Article 9 of the Code of Conduct for Responsible Fisheries, and particularly Article 9.1.5.

Essentially, the Choluteca Declaration's demand for a moratorium and period of transition, monitored by an independent global body, is a call for international cooperation in order for minimum social and environmental standards to be multi-laterally set by responsible governments and implemented by an industry operating in a highly competitive world market. In order to internalize some of the environmental and social costs and shape policies to prevent or mitigate those costs which cannot be internalized, enforceable, international standards dealing with the shrimp industry's externalities are necessary **(Barraclough and Finger-Stich 1995. p.37)**. International standards are urgently needed because, due to the highly competitive nature of the sector, the shrimp aquaculture industry is incapable of regulating itself , nor is it likely that its constituent individual investors and companies voluntarily internalize the costs of environmental and social damage on their private accounting ledgers.

### *9.3 Governments acting irresponsibly:*

While the level of environmental awareness and concern has been steadily increasing in developing countries where shrimp aquaculture has taken hold, the extent to which the public concerns for environmental protection can place an effective demand for action on government is still limited. In the few instances where they have been conducted, environmental impact assessment programs have failed to provide sufficient opportunity for public input and concerns to be accounted for in the planning and approval of development projects. Under pressure from national elites, bolstered by transnational corporates, powerful and strongly hierarchical bureaucracies play a major role in furthering the shrimp aquaculture push, are protective of their power and influence, and are reluctant or unable to cooperate for environmental management purposes **(Boyle 1990)**. At the same time, environmental agencies in developing countries, some which are relatively new and frequently underfunded, must work to strengthen their capacities for monitoring and enforcement matters pertaining to coastal environmental protection.

With regard to laws that are said to be on the books in most of the countries where shrimp farming has become a problem, experiences have shown that what regulations there may be to enforce on shrimp farm operations will simply not be enforced in the main. There are many reasons why, from lack of resources, difficulties in implementation, to corruption, among others. For instance, in Thailand there is currently a fundamental conflict between the law enforcement and extension roles of key government staff involved in shrimp farm monitoring. Farmers will not participate in information exchanges over detailed aspects of pond management and marketing with extension officers who are also responsible for law enforcement activities and likely to charge them with any breaches of the law. District Fisheries Officers in Thailand are reportedly currently in this situation **(Claridge 1996, p8)**.

Despite the regulations established by the Thai Ministry of Agriculture and Cooperatives in 1991 requiring all shrimp farms to be registered, virtually none are **(Claridge 1996 p.8)**. Most shrimp farms in excess of eight hectares that are required to build water treatment facilities or sedimentation ponds do not have them installed. In most areas no testing of discharge water quality is done and there are no prosecutions for exceeding the 10 mg/l standard for Biological Oxygen Demand (BOD). And the visible evidence of pond sediment disposal by the roadside or on other public lands and the discharge of pond water into farmland or waterways is proof that the present laws are being blatantly flouted **(Claridge 1996, p8).**

In India, if shrimp aquaculture has proven to be a highly destructive industry, both ecologically and socially, it is not for the want of laws and regulations in the book. The primary challenge in the Supreme Court to coastal shrimp aquaculture in India came when it was pointed out that more than 90 percent of the industrial or entrepreneurial coastal farms violated the rules laid out in the February 1991 Coastal Regulation Zone notification under the Environment Protection Act, 1986. The Coastal Regulation Zone aims to regulate development within 500 metres of the High Tide Line all along the Indian coast.

However, it is patently clear that the industry and the implementing and abetting authorities seemed more intent to rapidly promote the dollar-earning industry even while ignoring legislation that existed even prior to February 1991. For instance, Section 25 of the Indian Water (Prevention and Control of Pollution) Act, 1974, bars any person from "setting up any industry, operation, process or treatment and disposal system. . .which is likely to discharge sewage or trade affluent into a stream or well or sewer or on land. . ." However, only a handful of shrimp aquaculture units are known to have applied for permission under the Water Act.

When the Government was shown to be violating its own laws by aiding shrimp aquaculture in coastal areas, rather than change its actions to abide by the law, it has sought to change the law. In Karnataka, the State Government amended its Land Reforms Act in 1995 so that a ceiling on land ownership was lifted for aquaculture. Incidentally, the original act was meant to facilitate social equity in land distribution. The amendment, not surprisingly, resulted in land alienation and social disharmony.

In another instance, the Supreme Court interpreted the Government's Coastal Regulation Notification to issue a ban on coastal industrial shrimp aquaculture within 500 meters Coastal Regulation Zone via a December 1995 judgment. The Indian Government, spurred by the shrimp aquaculture industry, has sought to respond by tabling the Aquaculture Authority Bill which excludes aquaculture from the scope of the Coastal Regulation Zone Notification.

It is not enough that the producer countries such as Thailand, India or Ecuador pass rigid environmental laws; the means are needed to attain standards and the ability to enforce regulations, which have proven to be illusive thus far. Regional or global multinational treaties such as the ASEAN Agreement on Conservation, the Convention on Biological Diversity or the 1971 Ramsar Convention on Wetlands of International Importance could support, for example, protection for remaining mangrove forests from shrimp farm expansion. With regard to Ramsar, for instance, it is worth briefly noting here that in relation to the international trade in farmed shrimp, Japan, the U.S. and European Union (all signators to Ramsar) are apparently violating at least the spirit of that Convention by either importing the bulk of internationally traded farmed shrimp from tropical countries where mangroves and other critical wetlands have been or are being badly affected, or are allowing their national corporate and private investors to finance, or join in business ventures in, shrimp farms that denigrate mangrove forests and other critical wetlands.

### *9.4 Shrimp consuming countries must take responsibility too (because they are not):*

Support from other nations, particularly the US, Japan, and the European Community countries is critically needed if the environmental and food security threats posed by shrimp aquaculture are to be eliminated. These nations are the primary importers of farmed shrimp and have the means, technologies, and perhaps even enforcement capabilities to enable tropical countries to preserve their coastal resources. Accelerated economic growth has not been effective at reducing environmental problems, and foreign encouragement and assistance are necessary, and possibly even multi-lateral arrangements specially directed at overseas investments in shrimp aquaculture and at farmed shrimp imports.

It has been argued that shrimp importing countries, the U.S., Japan and the EU, are not doing all they could to ensure that their shrimp consumption habits aren't causing any significant environmental damage. There are precedents for the government's of the big-three importing countries to intensify their protection actions. After publication of a report by The Natural Resources Defense Council showing that between 1973 and 1988 nearly one-third of Indonesia's eighty million acres of peat swamplands, mangroves, and freshwater wetlands had been destroyed, the US moved to tie wetland protection with foreign assistance **(IER 1988)**. The Treasury Department directed US representatives to oppose projects to be funded by multilateral development banks (including the World Bank, Inter-American Development Bank, African Development Bank, and the Asian Development Bank) that destroy wetlands. The two principal guidelines were that projects should preserve the hydrological regime of wetland ecosystems and that projects should ensure the preservation of the ecological, species, and genetic resources within the region **(IER 1988).** However, the U.S. has been providing assistance to shrimp projects in Latin America that may be linked to wetlands damage.

To some extent as well, Japan has also assisted the cause of wetlands protection by funding research and reforestation projects. For example, in 1990 the International Society for Mangrove Ecosystems was founded at the University of the Ryukyus in Okinawa, Japan **(IER 1990a)**. Japan has also given money through the Asian Development Bank for mangrove reforestation projects in the Philippines and funding for mangrove forest protection throughout the world **(IER 1990b)**. And there are numerous other examples of assistance projects aimed at the protection and/or restoration of wetlands and mangroves by Japan, various European and Scandinavian countries and the U.S., either through their bi-lateral agencies or by way of funds made available through intergovernmental agencies such as the UN and the World Bank Group.

Multi-lateral efforts, involving farmed shrimp exporting and importing countries, to confront the destructive aspects of the world shrimp trade will inevitably be much stronger than unlilateral action by individual (e.g. importing) nations. International treaty enforcement, domestic legislation, adherence to FAO guidelines found in Article 9 and other Articles of the Code of Conduct for Responsible Fisheries, and bioremediation (e.g. mangrove restoration) can work together to help preserve coastal environments in shrimp-producing countries. Failing multi-lateral international efforts, it has been suggested that the U.S., Japan, the EU and other major shrimp importing countries should impose import regulations to ensure that shrimp farms are not created or operated at the expense of the coastal environment **(Knud-Hansen 1995).** Some believe these measures are necessary to keep under control "[a] powerful 'new' class of professional aquaculture development specialists and national elites [who] sustain the vested interests behind international capital flows at the expense of natural ecosystems, long-standing occupations, and wider segments of the population". **(Skladany 1992).** Shrimp-importing nations, it is argued, should assume sufficient responsibility to ensure that their appetites for shrimp are not being satisfied at the expense of fragile (and valuable) coastal ecosystems **(Knud-Hansen 1995).**

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## ANNEX 1: CHOLUTECA DECLARATION ON UNSUSTAINABLE SHRIMP AQUACULTURE

**From the NGO Forum on Aquaculture and its Impacts**
**Choluteca, Honduras; 13-16 October, 1996**

We, the delegates of twenty-one non-governmental and community organizations from Latin America, North America, Europe and Asia, the participants in the Choluteca Forum on Aquaculture and its Impacts, express the following declarations and demands to the international community:

WE DECLARE

Our concern over the increasing environmental destruction evident world wide, and in particular the destruction of mangrove forests, estuaries, and lagoons; and, in general, we declare our deep concern over the conversion of coastal wetlands and areas to shrimp farms, an unsustainable activity that is growing in an uncontrolled manner throughout the tropical and subtropical regions of the world.

WE DECLARE

Our concern over the deprivation, displacement and marginalization of native communities that depend on coastal wetlands, due to the establishment of shrimp farms in these areas.

WE DECLARE

That the lack of planning for an integrated marine and coastal area development is an assault against biological diversity, by allowing for the destruction or contamination of habitats and, amongst other acts, allowing for the wholesale elimination of marine life that is captured incidentally in the harvest of wild shrimp post-larvae used to supply the majority of shrimp farms in the world.

WE DECLARE

Our desire for the imposition of a global moratorium to halt the further establishment or expansion of shrimp farming and that responsible parties undertake a study to determine the best means to transform shrimp aquaculture into an activity which is equitable and ecologically compatible with the principles of sustainable development.

During the moratorium, a period of transition or conversion from the use of destructive technologies or practices to more responsible practices should be initiated to ensure the long term survival and health of ecosystems and the viability of a variety of sustainable human activities dependent on those systems.

WE DECLARE

Our support for the criteria set forth in the NGO Declaration on Unsustainable Aquaculture to the United Nations Commission for Sustainable Development in May 1996. Therefore:

WE DEMAND

The implementation of the afore-mentioned criteria and those which are detailed as follows:

DEMAND #1

Guarantee that the development and operation of various types of aquaculture, in particular shrimp aquaculture, does not, in the short, medium or long term, adversely affect biotic and abiotic environments and artisanal fisheries and the communities which depend on them.

DEMAND #2

Ensure that shrimp aquaculture and other forms of coastal development are conducted within an integrated plan of management that includes the real and effective participation of all groups that benefit from coastal resources, in particular local communities.

DEMAND #3

Ensure that the development of shrimp aquaculture is compatible with the structure and function of natural ecosystems and with the socio-cultural and economic interests of coastal communities andtheir areas of concern.

DEMAND #4

Ensure that multilateral development banks, bilateral aid agencies, agencies of international cooperation, the FAO and other relevant national and international organizations and institutions do not finance or promote in any way the development of shrimp aquaculture practices which are not consistent with these demands.

DEMAND #5

Prior to the development of any shrimp aquaculture activities, require an evaluation of the environmental, social and cultural impacts involving the participation, in a decision-making capacity, of NGOs and peoples potentially impacted; in addition, require environmental audits of existing operations on an ongoing basis with the same mechanisms for participation.

DEMAND #6

Guarantee respect for the Human Rights of all people affected by shrimp aquaculture. Where human rights violations occur, they must be investigated by the competent authorities and processed in accordance with the civil, administrative and judicial responsibilities of the country concerned in compliance with the laws, treaties and international agreements to which such countries are parties.

DEMAND #7

Regulate the use of fresh water in shrimp aquaculture operations with due regard to the ecological costs or impacts on the watersheds and basins where they are located, the need for freshwater supplies for human consumption, and the supply of water for other activities (e.g. agriculture, industry, tourism, urban development); and prohibit the salinization of fresh waters supplies including groundwater and reservoirs.

DEMAND #8

Ensure the protection of wetland areas, in particular mangrove forests, rivers, lagoons, inlets, bays, estuaries, swamps, marshes and tidelands.

DEMAND #9

Prohibit the use of substances harmful to the biodiversity of the area impacted by shrimp aquaculture operations.

DEMAND #10

Apply the precautionary principle to every step in the development of shrimp aquaculture.

DEMAND #11

Prohibit the contamination of surrounding areas as a result of the excessive discharge of organic and inorganic wastes.

DEMAND #12

Prohibit the introduction and the use of organisms modified by genetic engineering and support the establishment of strict international measures relating to biosafety.

DEMAND #13

Prohibit the use of exotic (non-native) species and stimulate research into methods for the in-vitro reproduction of native species.

DEMAND #14

Prohibit the conversion of land used for agriculture or livestock production to use for shrimp aquaculture production, with particular attention placed on land-use management planning and national food security.

DEMAND #15

Prohibit the use of feeds for farmed shrimp consisting of fish that could be used for human consumption.

DEMAND #16

Ensure that the capture of shrimp larvae and any other type of activity does not adversely affect the survival and diversity of other species.

DEMAND #17

Ensure that the shrimp aquaculture industry assumes all civil, legal (and corporate) responsibilities for the socio-environmental damages caused by the industry's installations, operations and production.
The burden of proof that no damage has been done rests with the industry.

DEMAND #18

Finally, we demand a global moratorium on any further expansion of shrimp aquaculture in coastal areas until the criteria for sustainable shrimp aquaculture are put into practice. We also demand the formation of an independent body of national, regional and international organizations, including non-governmental organizations, to monitor the implementation of this process at the global level.

Based on these demands, the organizations that endorse this declaration agree to unite their efforts and to work together to pressure governments, producers, and financial institutions as well as consumers to put these demands into practice as soon as possible.

The Non-Governmental Organizations present have approved a plan of action to begin a process of investigation, denunciation, education and public pressure to confront the activities of unsustainable shrimp aquaculture.

The following organizations support the present declaration:

Accion Ecologica, Ecuador
- Amigos en defensa de la Gran Sabana (AMIGRANSA), Venezuela
- Asociacion Ecologica Santo Tomas, Mexico
- Asociacion Unionense para el Medio Ambiente (ASUMA), El Salvador
- Centro de Estudios de Tecnologia Aplicada (CESTA), El Salvador
- Centro de Estudios Integrales del Ambiente (CENAMB),
- Universidad Central de Venezuela
- Comite para la Defensa y Desarrollo de la Flora y Fauna del Golfo de Fonseca (Coddeffagolf), Honduras
- Desarrollo Ambiente y Sociedad (DAS), Mexico
- Fundacion Ecologica de Muisne (FUNDECOL), Ecuador
- Greenpeace International

- Instituto Terramar, Brasil
- Jovenes Ambientalistas (JA), Nicaragua
- Mangrove Action Project (MAP), USA
- Movimiento Ambientalista de Nicaragua (MAN)
- Movimiento de Pescadores Riberenos y Aguas Interiores, Mexico
- Natural Resourses Defense Council (NRDC), USA
- Organizacion de Comunidades Negras, Colombia
- PREPARE, India
- Swedish Society for Nature Conservation, Sweden
- Tumbes Silvestre, Peru
- Union Nacional de Organizaciones Ecologistas (UNES), El Salvador

## ANNEX 2: NGO STATEMENT CONCERNING UNSUSTAINABLE AQUACULTURE TO THE UNITED NATIONS COMMISSION ON SUSTAINABLE DEVELOPMENT, MAY 1996

In recent years, aquaculture development has been repeatedly promoted as a solution to meet growing world food needs from fish. Traditional forms of aquaculture can and have made substantial contributions to food supplies in areas of the world where food needs are most acute. However, recent patterns of aquaculture development have emphasized the production of high value species for export markets. In particular, the rapid development and expansion of intensive aquaculture for shrimp has resulted in widespread degradation of the environment, displacement of coastal fishing and farm communities, and a negative impact on local food supplies and food security.

The FAO Code of Conduct for Responsible Fisheries in Article 9 urges responsible aquaculture development. National and regional implementation of the FAO Code, the Convention on Biological Diversity and other existing laws and policies, must be pursued in a manner which ensures that unsustainable aquaculture is prohibited before there is irreversible damage, loss of biodiversity, or harm to coastal communities.

The undersigned Non-governmental Organizations (NGOs) urge governments to agree to:

1. Ensure that artisanal fisheries and dependent coastal communities, and their access to community resources, are not adversely affected by aquaculture development or operations, including extensive and semi-intensive as well as intensive aquaculture methods.
2. Ensure the use of environmental and social impact statements prior to aquaculture development and the regular and continuous monitoring of the environmental and social impacts of aquaculture operations.
3. Ensure the protection of mangrove forests, wetlands, and other ecologically sensitive areas.
4. Prohibit the use of toxic and bioaccumulative compounds in aquaculture operations.
5. Apply the precautionary approach to aquaculture development.
6. Prohibit the pollution of surrounding areas resulting from the excessive discharge of organic wastes.
7. Prohibit the development and use of genetically modified organisms.
8. Prohibit the use of exotic/alien species.
9. Prohibit the use or salinization of fresh water supplies, including groundwater, important for drinking or agriculture.
10. Prohibit use of feeds in aquaculture operations consisting of fish that can be consumed by people.
11. Prohibit the wholesale conversion of agricultural or cultivable land to aquaculture use.
12. Ensure that the collection of larvae does not adversely affect species biodiversity.
13. Ensure that abandoned or degraded aquaculture sites are ecologically rehabilitated and that the companies or industry responsible bear the costs of rehabilitation.
14. Ensure that aquaculture and other coastal developments are addresses in integrated coastal zone management planning which includes the meaningful participation of all coastal user groups.
15. Ensure the development of aquaculture in a manner which is compatible with the social, cultural and economic interests of coastal communities, and ensure that such developments are sustainable, socially equitable and ecologically sound.
16. Ensure that multi-lateral banks, bilateral aid agencies, and the UN Food and Agriculture Organization and other relevant national and international organizations or institutions do not fund or otherwise promote aquaculture development inconsistent with the above criteria.

This statement has been endorsed by the following NGO's:

Accion Ecologica, Ecuador,
Christian Aid, UK,
Coalition of Environmental NGOs, Bangladesh,
Consumers Association of Penang, Malaysia,
CODDEFFAGOLF, Honduras,
Dessarrollo Ambiente y Sociedad, Mexico,
Earth Island Institute, USA,
Environmental Defense Fund, USA,
Greenpeace International,
Indigenous Community Rights Forum, Papua New Guinea,
International Collective in Support of Fishworkers,
Mangrove Action Project,

Movimiento Nacional Pescadores Riberenos, Mexico,
Nijera Kori, Bangladesh,
Ocean Advocates, USA,
Orissa Krushak Mahasangh, India,
Peoples Action Against Shrimp Industry,
India, PREPARE, India,
Sahabat Alam Malaysia,
Sierra Club Canada,
Sea Turtle Restoration Project, USA,
Swedish Society for Nature Conservation,
Third World Network,
Yadfon Association, Thailand

# SUBMISSION OF THE INTERNATIONAL COLLECTIVE IN SUPPORT OF FISHWORKERS

by

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## INTRODUCTION

It is two years now since the Code of Conduct for Responsible Fisheries was adopted by the FAO Conference and we would like to thank FAO Fisheries Department for organising this highly relevant Technical Consultation on Policies for Sustainable Shrimp Culture. We are happy to be here at this Consultation. The co-operation established during the Code process with NGOs thus continues into more specific areas now.

The International Collective in Support of Fishworkers (ICSF) works to defend the right to life and livelihood of artisanal and small-scale fishworkers especially in the South. Although ICSF's main area of work is related to marine fisheries, it is concerned about coastal aquaculture because of the implications of such developments for fishworkers and their communities. At the South Asian Workshop and Symposium on Fisheries and Coastal Area Management organised by ICSF in Madras from 26 September to 1 October 1996, problems caused by shrimp aquaculture development in the South Asian region were discussed from the perspective of fishworkers.

## PROBLEMS OF FISHWORKERS FROM INDISCRIMINATE SHRIMP AQUACULTURE

The main reason for the boom in shrimp aquaculture is a growing market for shrimp in the North in conjunction with stagnant or reduced supplies from capture fisheries in the South. The wild stocks are already heavily overfished as a result of unselective bottom trawling in the coastal waters and destructive fishing of shrimp juveniles in lagoons and backwaters. The negative ecological and social impact of bottom trawling has been a matter of tremendous tension in the Asian region for at least twenty years, prompting several countries to create an exclusive zone in the coastal waters for the artisanal fishers. Indonesia even banned trawling in the 1980s. The plight of fishers is now complemented by the indiscriminate development of shrimp aquaculture.

Almost the entire production of shrimp from aquaculture is in the developing countries and, therefore, the impacts of shrimp aquaculture are of particular concern to fishworker organisations in several Asian and Latin American countries. Fishworkers in countries like Bangladesh, India, the Philippines, Sri Lanka, Thailand, Ecuador, Peru, Mexico and Chile have expressed strong concern about the chaotic development of shrimp farms in the coastal areas for at least five reasons.

First, they fear that their traditional fishing grounds are getting depleted as a result of destruction of mangroves and gleaning of gravid females and post larvae from the coastal waters. They protest the incidental destruction of fish larvae and the loss of nursery grounds of fish in this process. The diversity of species in the coastal areas has declined as a result in many places.

Second, they are incensed about interference in their fishing activities by shrimp aquaculture operations. Passive fishing operations are sometimes disrupted by onshore installations to pump seawater. Moreover, fish also show a tendency to avoid fishing grounds affected by turbidity from shrimp farm effluents and by noise pollution due to pumping seawater.

Third, they resent the loss of traditional access rights to the village commons. They are sometimes denied access to their fishing grounds by obstructing shrimp ponds and they often have to take a different, far longer route to the fishing ground from their settlements. Further, fishworkers are also deprived of space to dry fishing nets and to process their fish.

Fourth, they protest the disruptions to their community life and to their non-fishing activities. There are instances where drinking water sources have been contaminated. Subsistence farming operations have also been hindered by salinity. The village commons, used for grazing heads of cattle, for collecting firewood and for fulfilling other primary needs have suddenly become inaccessible or degraded. These, in particular, have increased the workload of women in the fishing communities. Off-season employment opportunities for fishworkers in farming operations have also declined.

Fifth, they apprehend the development of the fishmeal industry since the demand for fishmeal and fishoil may lead to fishing down the food chain with adverse consequences for fisheries, especially in Asia. Fishmeal and fishoil are two of the principal components of shrimp feed. Thailand, for example, reduces about 60 per cent of its total marine fish production into fishmeal, which has serious implications for the capture fisheries of the artisanal sector. Moreover, the stick water from fishmeal plants has polluted the shell fishing grounds of artisanal fishers in many places in Peru and Chile.

## NEED FOR A REGULATORY FRAMEWORK

While the disruptions to coastal fishing activities and the inconveniences to fishing communities are well known, no serious attempts are made as yet to systematically document the negative impacts and to draw viable policies to remove such impacts in the long run. There are no effective regulations to manage shrimp aquaculture in a socially and ecologically responsible manner. The apparent potential for huge economic returns, in the short run, including foreign exchange earnings, has led governments and business interests to ride roughshod over the long term interests of fishing and other coastal communities. The expected rate of return on investment in shrimp aquaculture does not take into consideration the true social, economic and ecological costs. Once such costs are internalised, the economic rationale to pursue resource-intensive shrimp aquaculture development may cease to exist. Unless there is an effective regulatory regime based on sound principles, shrimp aquaculture will continue to cause problems.

## TOWARDS AN EFFECTIVE POLICY FRAMEWORK

Definition of sustainable shrimp aquaculture has to take into serious consideration ecological, economic and social aspects. The following ten points should be urgently taken up while developing an effective monitoring and control system for shrimp aquaculture.

### *(1) Recognise the right to life and livelihood of fishworkers*

States should make every effort to ensure that fishworkers are not adversely affected. while developing shrimp aquaculture industry. Their right to a secure and just livelihood and their access to fishing grounds should be protected. In this context, States should uphold article 6.18 of the Code of Conduct for Responsible Fisheries:

> *6.18 Recognizing the important contributions of artisanal and small-scale fisheries to employment, income and food security, States should appropriately protect the rights of fishers and fishworkers, particularly those engaged in subsistence, small-scale and artisanal fisheries, to a secure and just livelihood, as well as preferential access, where appropriate, to traditional fishing grounds and resources in the waters under their national jurisdiction.*

### *(2) Implement Article 9 of the Code of Conduct for Responsible Fisheries*

We are happy to notice the importance this consultation attaches to Article 9 of the Code of Conduct for Responsible Fisheries. We would specifically urge this consultation to attach special significance to the following paragraphs and to incorporate them into regulatory mechanisms:

> *9.1.1 States should establish, maintain and develop an appropriate legal and administrative framework which facilitates the development of responsible aquaculture.*
>
> *9.1.2 States should promote responsible development and management of aquaculture, including an advance evaluation of the effects of aquaculture development on genetic diversity and ecosystem integrity, based on the best available scientific information.*
>
> *9.1.3 States should produce and regularly update aquaculture development strategies and plans, as required, to ensure that aquaculture development is ecologically sustainable and to allow the rational use of resources shared by aquaculture and other activities.*
>
> *9.1.4 States should ensure that the livelihood of local communities and their access to fishing grounds are not negatively affected by aquaculture developments.*
>
> *9.1.5 States should establish effective procedures specific to aquaculture to undertake appropriate environmental assessments and monitoring with the aim of minimizing adverse ecological changes and related economic and*

*social consequences resulting from water extraction, land use, discharge of effluents, use of drugs and chemicals, and other aquaculture activities*

***(3) Set up participatory regimes for aquaculture regulation***

States should set up regulatory regimes for shrimp aquaculture with the participation of all stakeholders including fishworkers. Additionally, the practice in some countries, in relation to salmon aquaculture, of prior notification of areas that could be brought under aquaculture operations subject to no objection from the communities living in the vicinity of those areas, should be adopted in shrimp aquaculture.

***(4) Ensure compatible legislation and greater co-ordination between agencies***

States should provide a cohesive set of legislation for the management of shrimp aquaculture and should ensure greater co-ordination between the industry, finance, trade, agriculture, forestry, fisheries and other relevant departments at the national and local levels in planning, implementing and monitoring of shrimp aquaculture activities.

***(5) Establish Environmental Impact Assessment (EIA) procedures***

Before granting approval to shrimp aquaculture operations, States should make environmental and social impact assessment procedures mandatory. EIAs must be prepared in the context of existing activities in the area and their likely burden on the ecosystem. All EIAs should account for the social, economic and ecological costs due to shrimp aquaculture. Further, there should be provisions for a public review process.

***(6) Adopt a precautionary approach***

Given the extent of negative externalities arising from shrimp aquaculture and also taking into consideration the state of poor knowledge about the impacts of shrimp farming, it is important to apply a precautionary approach to shrimp aquaculture development. This should be done not only from an ecological point of view, but also from an economic and social point. Any attempt at promoting aquaculture should be made only after looking at its likely consequences for other sectors, especially marine capture fisheries.

***(7) Introduce ecolabels in shrimp aquaculture***

It may also be worthwhile to develop ecolabels to certify that a particular kind of shrimp aquaculture operation has been carried out in a responsible manner. This could be possible after developing a set of criteria for sustainable aquaculture in consultation with all significant stakeholders, including fishworkers, under the aegis of the State and/or non-State agencies.

***(8) Withdraw financial support to irresponsible aquaculture practices***

Governments, multilateral and bilateral agencies should withdraw credit support to all forms of shrimp aquaculture that are socially irresponsible and ecologically destructive.

***(9) Implement Compensation mechanisms***

Penal clauses should be introduced in national legislation to ensure that the aquaculture industry pays for the damages it causes to the environment and to the life and livelihood of fishworkers and other coastal communities.

***(10) Minimise dependence on fishmeal and fishoil as a source of feed***

It may further be worthwhile to discourage aquaculture practices dependent on fishmeal and fishoil that are manufactured from fish caught using destructive fishing practices. Preference should be given to shrimp aquaculture practices that are dependent on locally produced feed and which can be integrated into fishing and farming operations.

## Conclusion

Any form of aquaculture activity that leads to the destruction of mangroves and incidental destruction of fish larvae, should be regulated. Interference by aquaculture activities in fishing operations and in accessing fishing grounds and village commons should be completely stopped. All disruptions to community life in coastal areas should be prevented. A precautionary approach should be adopted for shrimp aquaculture development. Viable aquaculture regulatory bodies should be set up with the participation of all stakeholders, including fishworkers. Coastal States should uphold the interests, as well as the right to life and livelihood of fishing communities.

We hope this Consultation can contribute substantively to developing a purposive policy framework to address the negative impacts of shrimp aquaculture, especially on the artisanal and small-scale fishworkers of the South.

# THE WORLD WIDE FUND FOR NATURE (WWF) AND SHRIMP AQUACULTURE

by

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## INTRODUCTION

The last two decades have witnessed a rapid expansion of shrimp aquaculture throughout the world, particularly in Asia, driven primarily by demand for shrimp from consumers in Japan, North America, and Europe. Although the full range and magnitude of the impacts of this on the coastal environment and biodiversity and in socio-economic terms have yet to be fully documented and understood, in many locations commercial shrimp farming has devastated fragile coastal ecosystems, causing mangrove destruction, coastal erosion, pollution of surface and ground water including salinisation of vital coastal freshwater aquifers and release of antibiotics, and in some cases introduced exotic species. The few cost-benefit analyses performed to date have indicated that the cost of natural resource depletion and degradation and environmental damage far outweighs the direct economic returns from the industry.

Furthermore, many shrimp farms have to be abandoned after 5 to 6 years often rendering the land unfit for any other productive use. Substantial areas of ecologically and economically productive coastal lands have met this fate. Some of these lands may be reclaimed in the future, but there is urgent need for research on and investment in financially-viable reclamation activities.

Shrimp aquaculture, as it is currently practiced in many parts of the world, provides a striking example of unsustainable use of natural resources for export markets. As well as seriously damaging the environment, shrimp aquaculture can also undermine food security at the local level and reduce prospects for future development and poverty alleviation. The industry has triggered serious social conflicts in some locations by marginalising village communities and the poor. In many cases, while a few individuals benefit from this industry, many more see their livelihoods and local environment and resources damaged or destroyed.

WWF believes that many forms of shrimp aquaculture are destroying fragile tropical coastal ecosystems and disturbing the livelihoods of local communities. Shrimp farming is often ecologically, socially, and economically unsustainable, both in the short-term and in the long-term when the consequences may prove to be economically disastrous. The industry should therefore convert to more environmentally-sound production methods and, where production has proven to be inherently unsustainable, it should be closed down and appropriate measures taken for reestablishment of these coastal zones.

Diverging from the point of view of many in the industry and of consultants working with them, it is not our belief that the environmental and social problems caused by commercial shrimp aquaculture are the result of a few rogue producers out to make a quick buck. Rather, we believe that shrimp aquaculture is a new industry and that many mistakes have been, and are being, made. These mistakes are not limited either to large or small producers, or to any specific country. In fact, in some instances, changing local conditions have turned relatively benign practices into unsustainable ones. For example, many ecosystems can probably support one or a few shrimp farmers, but perhaps not a cluster of one hundred or more. Similarly, regulations and monitoring systems designed for extensive shrimp production are not adequate when land prices increase and more intensive management systems become the norm. For obvious reasons, producers and governments alike have been reluctant to close ponds to maintain the proper ecological balance.

What is required now is the identification of overarching principles for shrimp aquaculture. The devil however lies in the detail. How these principles are translated to specific practices which can be applied at a national, regional, ecosystem, and even pond level will be the true test of commitment to sustainability.

## WWF'S INVOLVEMENT WITH SHRIMP AQUACULTURE

For several years now, WWF International, WWF's National Organizations and Programme Offices, and local partners throughout the world have become increasingly concerned about the environmental and social impact of shrimp aquaculture. The organization's response has been to undertake a number of studies to try to understand the industry better at both a micro- and a macro-level, as well as to determine which issues have the greatest impact on biodiversity and are therefore the highest priority for WWF. From these analyses, WWF has developed a position statement on shrimp aquaculture and has moved to coordinate, consolidate where possible, and focus its various activities.

## Research Reviewing the Impact of Shrimp Aquaculture

WWF has commissioned two thorough, widely-disseminated overviews of the industry that have already significantly influenced the debate on sustainable shrimp aquaculture. The first study was published as a WWF/UNRISD working paper, **Some Ecological and Social Implications of Commercial Shrimp Farming In Asia** (Barraclough and Finger-Stich, 1996). The second study, reviewed by more than 200 shrimp aquaculture experts, is on **Market Potentials for Redressing the Environmental Impact of Wild-Captured and Pond-Produced Shrimp** (Clay, 1997a). These reports have been used as source materials for or have been cited in:

- articles in **Environment** (Gujja and Finger-Stich, 1996), **World Aquaculture** (Clay, 1997b), **Intercoast Network**, **Scientific American** (Boyd and Clay, in press), **The New York Times**, **The Wall Street Journal**, **The Journal of Commerce, Nature** and **The International Herald Tribune**;
- the World Bank's recent review of the environmental impact of shrimp aquaculture (Hempel and Winther, 1997); and
- presentations at the World Aquaculture Society, the UN Commission on Environment and Development, The Chamber of Shrimp Aquaculture in Ecuador, the Shrimp Tribunal hearings at the UN, and the up-coming American Association for the Advancement of Science meeting on sustainable shrimp aquaculture.
- the judgement of the Indian Supreme Court (11 December 1996) ordering the closure of shrimp farms in India that violate coastal zone regulations and damage the environment and the local economy.

As part of its' macroeconomic policy work, WWF-US is now developing policy options for identifying socio-economic root causes of biodiversity loss. The output of this work will be a dynamic framework for designing and implementing pragmatic responses to causes of biodiversity loss such as shrimp aquaculture. This work is intended to engage the GEF and, through it, the World Bank, UNDP, UNEP, and bi-lateral donors. Case studies are currently in preparation relating to shrimp aquaculture in the Rufiji Delta, Ruvu and Wami swamps of Tanzania; the Chilika Lake in India; and the mangroves of the Indus Delta and on the Baluchistan coast of Pakistan.

WWF is also working with a team of economists, environmentalists, and computer specialists from Massachusetts Institute of Technology (MIT) and Dartmouth University to model shrimp aquaculture production and trade. The goal of this work is to develop a better understanding of where and in what sequence interventions could be made in shrimp production and trade that would have the largest positive social and environmental impact with the least disruption of existing markets and trade.

Plans are also being made, through WWF-Philippines, to review best and worst shrimp aquaculture practices in the ASEAN region, with the aim of identifying and targeting methods that can be publicized for extension to other producers, as well as those that should be publicly opposed. A second proposal may be developed through WWF-International to undertake three benefit/cost analyses of shrimp aquaculture to the natural resource base, to local communities, and to government expenditures/revenues in different countries.

## Demonstration projects in the field

In Central America, WWF has been working with TNC and the University of Rhode Island (URI) along the Miskito Coast of Honduras and Nicaragua and the Gulf of Fonseca in Honduras, Nicaragua and El Salvador on the 'PROARCA/Costas' project. These activities focus on working with communities and NGOs to improve coastal resource management, and to strengthen local participation in decision-making, as well as policy and regulations, by coordinating closely with government authorities. In Honduras, where shrimp aquaculture has resulted in significant social, economic, and environmental impacts, the work has focused specifically on establishing criteria for zoning and shrimp farming concessions. WWF has also agreed to work with the URI to identify, analyse, and document better siting, production, and management practices in shrimp aquaculture throughout Central America. This project will not be limited to technical aspects but will also examine the important issue of how shrimp aquaculture can contribute to genuine development in coastal areas and address chronic socio-economic inequities. Efforts will then be made to obtain financial support for adapting and expanding these activities throughout the region.

In Hong Kong, WWF has overall management responsibility for the Mai Po Nature Reserve, where traditional shrimp aquaculture operations have been underway for many years as an integral part of the mangrove ecosystem (Cha et al., in press; Young, 1997).

In Tanzania, WWF has been playing an informational and advocacy role regarding a potential 10,000-ha shrimp aquaculture project in the Rufiji Delta. The organization has collected relevant information for government officials, NGOs, and the public, identifying the hazards of shrimp farming. WWF will provide every assistance possible to the government as it begins to draw up its overall aquaculture guidelines and legislation as well as specific policies related to shrimp.

### International Trade

WWF has completed two case studies which examine the shrimp trade between Japan and Indonesia. One of the studies examines the environmental and social impact of shrimp aquaculture production in Indonesia as well as the overall shrimp trade between the two countries, the structure of the industry, and some initial indications of what sustainable shrimp aquaculture might look like in Indonesia. The other study examined the structure of the Japanese shrimp market, identified the main players in it, and provided preliminary indications of appropriate points of intervention for future attempts to create demand for certified shrimp or shrimp from more sustainable sources.

The next phase of this work is intended to define sustainable aquacultural methods in Indonesia, and then devise multi-stakeholder strategies to encourage the adoption of those methods throughout the country. The success of this work will depend to a large extent on creating markets in the North for sustainably produced shrimp from Indonesia. Toward this end, WWF has compiled data on shrimp imports into the EU, by country, from Indonesia from 1990-1995 (Raymakers, 1997). This work will be essential if or when attempts are made in Europe to educate consumers about the importance of purchasing certified production from Indonesia. This approach may be replicable in other countries and or broader regions.

### Wild-Caught Shrimp

Because the current international shrimp market does not differentiate between wild-caught and pond-raised shrimp, it is very important to understand how the two product streams interact from the point of production, through processing, and into international trade. WWF's activities in this regard have been to:

- undertake a review of the environmental impact of the shrimp trawling industry (Clay, 1997a);
- begin to develop a WWF position on shrimp trawling;
- conduct workshops with Kenyan shrimp fishers on turtle excluder devices (TEDs);
- analyse the World Trade Organisation (WTO) shrimp/turtle dispute and prepare an Amicus brief on the topic (Cameron and Darroch, 1997);
- improve shrimp harvesting practices along the Miskito Coast of Nicaragua by helping local communities design, implement, and develop enforcement mechanisms for regulating shrimp fishing in lagoons; and
- support the replanting of mangroves in Sonmiani Bay, Pakistan to improve habitat for shrimp and halt declining shrimp harvests in the area.

## DEVELOPMENT OF INTERNATIONAL GUIDELINES FOR SUSTAINABLE AQUACULTURE

Many fora have been convened to undertake the important task of elaborating principles and guidelines for sustainable aquaculture. The Industrial Shrimp Action Network (ISA-Net), the Global Aquaculture Alliance (GAA), the Holmenkollen Principles (NENT, 1994), the World Bank (Hempel and Winther, 1997), Tesco's Code of Practice for Shrimp Growers, Earth Centre's Council for Sustainable Aquaculture, Soils Association's Organic Aquaculture Standards, Network of Aquaculture Centres in Asia-Pacific (NACA), World Aquaculture Society (WAS), and the American Academy of Arts and Sciences (AAAS), to name only some, are different groups that are examining either aquaculture in general or shrimp aquaculture in particular, with an eye toward identifying more sustainable practices that could be used as the basis for certification, educating consumers, or simply guiding their own work in the area of shrimp aquaculture. This FAO consultation is another case in point.

WWF has made a commitment, to the greatest extent possible, to be present and involved with any groups seriously attempting to develop guidelines for sustainable development. To date, these efforts have focused on the Holmenkollen Principles, discussions with the Ecuadorean Chamber of Shrimp Aquaculturalists, the Industrial Shrimp Action Network, the Global Aquaculture Alliance, and this FAO consultation. We will also participate in discussions at AAAS and WAS in February 1998. What is clear is that each of the entities discussing the issues answers to different, sometimes overlapping sets of players. None, however, represent all the stakeholders affected by shrimp aquaculture, and each of these groups will come up with its own set of guidelines.

As the discussions covering sustainability and specific guidelines take shape in early 1998, it will be essential to attempt to bring all these different groups to the same table, each with their own concerns and drafted guidelines, to discuss an overarching common set of guidelines and principles that can be accepted by the vast majority of the relevant players. Governments, industry, communities, academics, and NGOs will need to work together closely to identify the most appropriate guidelines and to oversee and monitor their adequate implementation. This, then, could be the basis for a broadly accepted, third-party certification program.

WWF's goal will be to encourage and assist with the creation of an on-going working group with representatives from each of the guideline development groups to come together to create an overarching international set of guidelines that could become the basis for a third-party certification program, similar to the Forest Stewardship Council (FSC) set up for timber, and the newly established Marine Stewardship Council (MSC) which is being set up for fisheries, both of which have major support and involvement of WWF. Certification of sustainable practices could be a market-based incentive for encouraging the adoption of best practices in both shrimp farming and fishing. To be effective, however, the guidelines would have to be developed through a legitimate multi-stakeholder process which does not yet exist for either shrimp trawling or shrimp aquaculture.

## TARGETS FOR SUSTAINABLE SHRIMP AQUACULTURE

It is also clear from the discussions that there are few, if any, "best" practices with regard to shrimp aquaculture. There are, however, a number of "better" practices that considerably reduce the environmental impact associated with the establishment and operation of shrimp aquaculture systems. At this time, there are very few ponds anywhere in the world whose operation could not be improved by the adoption of innovations. To date, the environmental issues that have been singled out for most attention are:

- loss of mangroves,
- eutrophication of natural waters by effluents;
- salinisation of freshwater and agricultural land by discharges;
- reduction of biodiversity (both aquatic and terrestrial);
- excessive consumption of water;
- use and release of chemicals and medicines, particularly antibiotics, into natural waters,
- sedimentation of natural waters,
- by-catch of the harvesting of post-larvae (PL) for aquaculture producers,
- introduction and escape of exotic species and/or diseased individuals.

Much of the discussion to date regarding the impact of shrimp aquaculture has focused on what happens inside the pond or with pond effluents. Gradually this has been expanded to include a more general discussion of the environmental and ecosystem carrying capacity issues listed above. Although these are extremely important issues, the FAO discussions on sustainable shrimp aquaculture should not focus on them to the exclusion of all the other relevant factors. Where a pond is built can have as much if not more to do with its sustainability than how it is run. Furthermore, the impact of shrimp aquaculture is not merely a technical one requiring technical fixes, even though better practices may involve the adoption of specific management or technical interventions. There are also important ecological, environmental, social, and indirect impacts outside the pond operation itself, that cannot be left out of discussions of sustainability. The adoption of best management practices will also require on-the-ground monitoring.

Finally, the proof of the efficacy of any principles or guidelines coming from the FAO consultation will ultimately be the individual changes in the behaviour of shrimp producers, consumers, and markets which collectively make the industry as a whole more sustainable. WWF's shrimp aquaculture initiatives have been identified because they address one or all of these concerns. Outlined below are some recommendations that the FAO should consider during its consultation on sustainable shrimp aquaculture.

On the Regulatory Side

- Ensure that the resource rights of local populations are respected in accordance with national laws and international conventions;

- In multi-user areas, give preference (e.g. permits, licences, subsidies) to shrimp aquaculture proposals that incorporate the economic interests of other stakeholders through joint venture, local equity, or Employee Stocks Option Plan (ESOP) ownership structures;
- Require Environmental Impact Assessments (EIAs) for all individual aquaculture projects (some analysts suggest that 90 percent of all subsequent environmental problems result from where the pond is built) and insist that they address ecological impacts outside as well as inside the pond, and provide sufficient baseline data on ground cover and water quality within an ecosystem for effective monitoring of the impact of the shrimp industry over time;
- Link permits, licences, and authorizations to on-going environmental performance;
- Consider environmental performance bonds, or royalty payments on annual production, to cover on-going costs associated with sustainable shrimp aquaculture that are incurred by society outside those associated with the individual pond.
- Require quarantine facilities for species shipped from one region to another;
- Require sterilization of introduced species before they are released into grow-out ponds and/or require anti-escape devices to be installed in ponds and require pond designs that protect against flooding and storm damage that could cause uncontrolled discharge;
- Prohibit the net conversion of mangroves and strategic wetlands for shrimp aquaculture and develop mechanisms to re-establish these ecosystems in areas where they have already been converted.

On the Production Side

- Require pond bottoms, canals, and levees to be sealed with compacted clay to eliminate salinisation of ground water;
- Prohibit the release of pond effluents into freshwater areas or onto agricultural lands;
- Prohibit the dumping of pond sediment in freshwater areas or on non-saline soils;
- Prohibit the use of freshwater in shrimp aquaculture ponds;
- Reduce the eutrophication of pond water by using moderate stocking and feeding rates and high quality feed with good feed management; reducing water exchange rates as much as possible, with 2-3% per day being the highest acceptable level; requiring the use of settlement ponds for all discharge or managed wetlands on the farm; and discharging pond water only in areas where it is quickly diluted and transported to the ocean. Qualitative standards could include the prohibition of a turbidity plume at the point where water is put back into the natural environment from the aquaculture system or of the discharge of odorous water. Quantitative standards could include such indicators as the maximum acceptable daily and monthly discharge rates, mg per litre levels of suspended solids in relation to the ambient receiving water; maximum and minimal acceptable levels of pH, ammonia, dissolved oxygen, nitrogen, and phosphorus, COD and BOD;
- Reduce sedimentation by: building levees with gradual slopes that minimize erosion; planting grass or other ground cover on levees to prevent erosion; compacting and lining the sides of ponds, channels, and levees to prevent erosion; making discharge and drainage channels large enough to prevent scouring; and leaving sediment in ponds unless it absolutely has to be removed.
- Retain water in ponds until any chemical residues have dissipated;
- Discourage any routine use of chemicals, antibiotics or other medications in the management of shrimp ponds and require that information on quantities used is made publicly available.
- Reduce impact on biodiversity by: eliminating the use of wild-caught PL; screening water intake pumps to reduce introduction of different species; preventing eutrophication of coastal waters from shrimp aquaculture discharges; preventing salinisation of freshwater; prohibiting the shooting of birds in or near shrimp ponds; retaining and/or planting riparian vegetation; and re-establishing abandoned ponds to their previous ground cover.

On the Social Side

- Create guidelines that protect the rights of other resource users and/or propose mechanisms acceptable to all stakeholders to resolve problems over conflicts arising from resource use;
- Design ponds in such a way that coastal communities continue to have access to coastal areas and fresh water;
- Prevent the degradation of resources that are key to the livelihood of other coastal residents;
- Give priority to shrimp aquaculture projects that employ local residents and/or that give local residents equity in local production and/or processing facilities.
- Monitor the local displacement from shrimp farming relative to the creation of jobs for local residents and give priority (or continued production licences) to those enterprises that perform best in this regard;

- Create innovative measures to monitor the impact of shrimp aquaculture such as the cost of food locally for a family compared to the average wages.

On the Market Side

- Create production, marketing, and trading guidelines that can give consumers confidence in the overall sustainability of shrimp aquaculture and allow them to support, with their purchases, those producers who are independently certified by third parties.

For those producers interested in sustainable shrimp aquaculture, it will be essential to ensure that technical assistance regarding better practices is available throughout the world. The largest impact would be achieved if technical assistance could be tailored to four types of countries:

- those on the frontier of shrimp aquaculture where production has not yet started,
- those where shrimp aquaculture is newly established and expanding rapidly,
- those with mature shrimp aquaculture industries that are not expanding, and
- those where shrimp aquaculture has peaked and is in decline.

Wherever expansion of shrimp aquaculture operations is anticipated, planned or underway, assistance should be conditional on and initiated only after participatory environmental and socio-economic impact assessments.

Some of the better practices will pay for themselves, usually after an initial investment by the producer, but costs of others will have to be passed along through the market chain and eventually covered by the consumer. In the case of practices that pay for themselves, in order to encourage their adoption, it will be extremely important to prepare analyses showing how the costs of sustainability can be covered through increased profits, reduced costs, or both. Where sustainable practices will cost more to the producers, it will be necessary to identify systemic strategies that not only allow the costs of sustainability to be passed on to the consumer but that also educate consumers so that they will choose to pay them. If such strategies cannot be developed, sustainable producers will be penalized and forced to cover the costs themselves.

## CONCLUSION

WWF is calling on all countries which are producing shrimp through aquaculture to review the social and environmental impacts of this industry in fulfilment of the requirements of Article 9 of FAO's Code of Conduct for Responsible Fisheries as well as the guidelines being developed in Bangkok. In line with recommendations in the Jakarta Mandate of the Convention on Biological Diversity, these governments should close or convert to sustainable production methods those farms causing damage following guidelines adapted to each region produced through a multi-stakeholder process.

WWF is also calling on all shrimp-producing countries to encourage more eco-friendly forms of shrimp aquaculture production, including both those based on traditional methods as well as those based on technological innovations and the adoption of best management practices where they contribute to sustainability. Examples of such measures would include:

- careful siting of shrimp ponds;
- prohibition of the net conversion of mangroves;
- use of indigenous species for pond culture;
- improvement in feed quality and feed management practices;
- encouragement of more closed systems (e.g. reduction of the use of water, the use of only hatchery produced fry, eventual domestication of shrimp);
- strict control of the release of wastes; and
- the inclusion of social issues in the decision about whether aquaculture should go ahead or not.

WWF wants to draw attention to the role of international financial institutions, such as the World Bank, other multi-lateral development banks, and bi-lateral agencies, in promoting and subsidizing this industry. We call on these agencies to link future financial assistance to the adoption of more sustainable production systems and "better" management practices in order to reduce the negative impact of the industry. This could include the expansion of the industry into new areas or retrofitting existing producers in areas where the industry is well established. By supporting research and development efforts, these agencies could help to develop and promote models for appropriate shrimp aquaculture.

Furthermore, the industry has already caused considerable damage to both the environment and to local communities in many countries, particularly in Asia. In some places this is estimated to be greater than the earnings made by the industry. International agencies, such as FAO, while concentrating on developing a sustainable industry for the future, should also not ignore or impede the task of rehabilitation of coastal ecosystems and compensation of local people, particularly in relation to contaminated drinking water, the diversion of water from local farmers, and salinisation. Both the industry, and the agencies that have supported it, should take responsibility for repairing past damage, and show a clear commitment to sustainable aquaculture by developing appropriate rehabilitation projects.

Since much of the existing investment in the shrimp industry is from private sources, WWF would like to encourage both domestic and international investors to back more eco-friendly forms of shrimp aquaculture. Potential investments could be screened through their use of comprehensive social and environmental impact assessments and multi-stakeholder consultations. Governments and financial institutions could encourage this behaviour on the part of private investors by making permits or co-financing conditional on it.

Finally, WWF proposes that shrimp consumers, who are ultimately responsible for the dramatic growth of the industry, can play an important role in encouraging more sustainable methods of shrimp production. Toward this end, WWF will support efforts to determine such methods and to develop valid third-party certification programs, such as the FSC and MSC, to create consumer confidence and to provide transparent mechanisms and economic incentives for the implementation of such measures.

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# A REVIEW OF THE LITERATURE ON SHRIMP CULTURE

by

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## Abstract

The objective of this paper is to provide a review of the literature on shrimp culture development in order to identify key policy issues. The key themes which emerge are examined from the perspective of economics, as a means of providing a general assessment of resource usage and policy. The paper is divided into four main sections: 1) Perspectives on shrimp culture; 2) Economic rationale of shrimp culture; 3) Problems with shrimp culture; 4) Conclusions. There are four main conclusions. Firstly, there is a lack of independent analysis of the factors affecting the production strategies of private firms in the shrimp industry, which may reflect a polarisation of viewpoints over the roles of different stakeholders within the industry (e.g. private companies vs. local communities). Secondly, there is clearly a need to overcome polarisation in order to promote sustainable shrimp culture development; the participation of all stakeholders in the policy formation process should be encouraged. Thirdly, there is a need for the shrimp culture sector to be viewed from a wider perspective, in order to facilitate clear analysis of problems and so appropriate policy responses. Many problems of the shrimp culture industry are examples of well documented problems of economic development in tropical countries. Fourthly, it is important that shrimp producers incorporate the external costs of production (e.g. pollution) into planning decisions. Otherwise, as witnessed in other sectors, these costs will be forced upon them, a process that may threaten the future of the industry. An appendix provides an assessment of the literature reviewed.

Key words: Shrimp culture; Literature review; Development economics; Problems and constraints; Development policy.

## INTRODUCTION

The development of large scale/intensive shrimp farming is a phenomenon of just the last two decades. The rate of growth of the industry world-wide has been very rapid and current production stands at around 700,000 mt (equivalent to about 25% of total world shrimp supply) (Rosenberry, 1997a). A number of factors have led to this growth. The growing world market demand for shrimp (mainly from North America, Europe and Japan), coupled with a levelling-off of production from capture fisheries, gave rise to high market prices in the 1980's. Simultaneously, the emergence of a technological package of hatchery reared post-larval shrimp (PLS) and balanced-diet feeds allowed large scale and production.

While new production technology and profitability provided incentives for private investment, international development agencies and national governments were keen to encourage shrimp production for export, in order to earn the foreign exchange needed to meet international debt obligations and to stabilise balance of payments positions.

The production and financial performance of the shrimp culture industry has been impressive. However, its rapid growth has led to a number of technical, environmental, economic and social problems, which have been widely reported in a burgeoning international literature.

The primary objective of this paper is to provide a review of the literature in order to identify pertinent policy issues for shrimp culture development. The emphasis is therefore on examining key themes within the unifying framework of development economics. Authors of different disciplines would provide different interpretations of the literature (i.e. anthropology e.g. Meltzoff and LiPuma 1986, political ecology e.g. Stonich 1995, ecology e.g. Larsson *et al.* 1994, Kinne, 1993, or sociology e.g. Bailey 1988, Bailey *et al.* 1996, Bailey 1997).

The paper is divided into four sections. In section one, the shrimp culture industry is viewed from the perspective of development economics. In the second section, the economic rationale for shrimp culture is discussed. The third section discusses the problems and constraints associated with shrimp culture. It provides the bulk of the paper and is divided into five sub-sections: technical, environmental, economic, social and institutional. Each sub-section concludes with policy perspectives and recommendations. A number of general conclusions are made in the fourth section.

An appendix provides an overview and assessment of the literature reviewed for this paper plus the many other references identified during the search. The bibliography lists all articles reviewed and cited in this paper.

## 1. PERSPECTIVES ON SHRIMP CULTURE

This section views the issues raised in the shrimp culture literature from the perspective of development economics. It is the perception of the authors that the literature reviewed was very largely industry specific, whereas many of the issues raised are clearly examples of more general phenomena, for which a wide and well developed literature already exist. It is hoped that this wider perspective, and an introduction to the wider literature, will assist in clear analysis of policy issues and the formation of appropriate policy responses.

- By its nature, shrimp culture is concentrated in tropical countries, which also tend to be less developed countries (LDC's), while the market for shrimp is concentrated in temperate, developed countries. Much of the context of shrimp culture is therefore concerned with the **development problems of LDC's** and the relationship between these countries and the developed countries' markets.

- The expansion of shrimp culture is (partly) due to a **change in technology**. In this sense it has similar effects to any other changes in production technology. (e.g. Ghatak and Ingersent, 1984, Chap 6, Coleman and Nixon, 1994, Chap 11.) Pearse (1980, p.6) states,

  **"...technologies and social relations are intimately linked and...a change in technology (is) virtually always associated with a major change in social relations."**

- The expansion of shrimp culture represents a move to **monocrop production** away from multi-crop/product production. In this sense it has environmental, economic and social effects of a similar nature to those of production of any other monocrop, be it sugar, or cotton, or cattle etc. (e.g. Boyce, 1992; Maxwell and Fernando, 1989).

- The expansion of the shrimp industry (part of the 'Blue Revolution') can be usefully compared with the **'Green Revolution'** of the 1960's and 70's. Many of the issues are the same and remain unsolved two decades later. (e.g. Pearse, 1980).

- Shrimp culture also represents a change from production for self-consumption and local market, to **production for export.** Again, its effects here are similar to movements into any other export crop, such as sugar or cotton.

- As an export crop, it may be viewed within the framework of **export-led growth and development strategies** - the foremost economic development strategies in LDC's in the last two decades. In this context, the arguments for and against the shrimp industry have already been rehearsed for other similar export industries and for the export-led strategy as a whole. (e.g. Stonich 1995, Coleman and Nixon, 1994, Chap 5).

- The expansion of shrimp culture has been driven by: at the micro-level, desire for profits, and at the macro-level, desire for foreign exchange earnings. It is thus a **market phenomenon**. Understanding the dynamics of the industry therefore entails understanding how the market and private agents operate (e.g. Rosenberry, 1997b and c). It follows that and the most effective ways of influencing the industry may well be through market based initiatives. (e.g. Soley *et al.*, 1994).

- The applied technology of shrimp aquaculture is still very young and is improving all the time under the influence of market forces. It may therefore be just a matter of **time** before modern intensive methods of shrimp culture are as environmentally and socially benign as the traditional methods practised for centuries in countries such as Indonesia. The development of the salmon farming industry in Northern Europe provides an interesting parallel experience from which the shrimp culture industry may be able to learn, (e.g. Coull, 1988).

- However, the technology of shrimp culture is, and in all probability will continue to be, **capital intensive** (financial, socio-political and human capital intensive). As such, it will not fit into the existing social, economic and production relations of small-scale rural farming communities. It implies change in the very basic parameters of rural life (e.g. Coleman and Nixon, 1994, chap 7).

- In this repect, the **choice of technology** within the shrimp culture industry is a key policy concern, given that a full range of shrimp production technologies now exist, from extensive systems relying on natural productivity to completely closed systems. They have very different implications for social, economic and production relations.

- Modern shrimp culture implies **large-scale change** of land use and ownership. It implies different habitation patterns. It implies different production relations and family livelihood strategies (e.g. undertaking wage labour). All these things have happened, are happening, and will continue to happen for some time, driven by the market.

- This type of change is part of the broad changes brought about during **capitalist development**. It implies raising productivity on the land, the transfer of labour out of agriculture and into industry, the incorporation of more economic activity into the industrial market structure - exactly what is happening via shrimp culture (e.g. Coleman and Nixon ,1994, chap 3.). If capitalist development is accepted, then the issue in the shrimp industry is not so much 'do we want change or do we not', but one of 'what can we do to manage that change in the least costly way'. Bailey (1988) raises the issue in reference to the shrimp culture industry thus,

  **"If, (however), development is perceived as a process through which improvements are made to the quality of life for society as a whole, rather than for certain classes or groups, current policies by national and international agencies need to be reconsidered."**

- Shrimp culture is just one aspect of the growing **aquaculture industry** and should be analysed in relation to aquaculture in general, including the culture of other aquatic species - especially more energy efficient, non-carnivorous species - in both land-based and sea-based operations, (e.g. OECD 1989, Nuruzzaman 1994, Bailey 1997).

- Pond-based aquaculture of shrimp is essentially an intensive **agricultural process**. It is a land-based activity, often directly replacing other agricultural processes on land. As such, it is better viewed within the legal and administrative framework of agricultural policies rather than that of other sectors e.g. fisheries or industry, (Bye, 1990).

## 2. ECONOMIC RATIONALE OF SHRIMP CULTURE

The shrimp culture industry has expanded in the last two decades under the rationale of providing economic benefits at national, regional, community and household levels, though it is the national level benefits which predominate in the literature.

The macro-economic benefits cited in the literature include: earning of foreign exchange (for debt repayment and balance of payments), diversification of the economy - especially the foreign exchange earning export sector, stimulation of backward and forward-linked sectors, creation of formal sector jobs, inflow of foreign direct investment and technological transfer (Bailey 1988, Born *et al.* 1994, Brigg and Funge-Smith 1994, Bye 1990, Datta 1995, DeWalt *et al.* 1996, Mahmood *et al.* 1994, Muluk and Bailey 1996, Stonich 1995, Stonich *et al.* 1997).

The foreign exchange argument has been the most forceful, in which context it is interesting to review the debt burden of some of the major shrimp culture nations (Table 1, overleaf). The burden of foreign debt can be a major incentive for countries to adopt short-term views with respect to the exploitation of renewable natural resources, leading to 'mining' rather than sustainable management. To the extent that this is a pressure on the shrimp culture industry, there may be a role for international lenders to link debt relief to improved performance on environmental aspects of shrimp farming i.e. as debt-for-nature swops.

**Table 1 - Debt indicators for farmed shrimp producing countries**

| | Tot. external debt per capita (US$) | Total debt service as a percentage of exports (%) | | Interest payments as a percentage of exports (%) | |
|---|---|---|---|---|---|
| | 1992 | 1980 | 1992 | 1980 | 1992 |
| Ecuador | 1116 | 33.9 | 27.1 | 15.9 | 11.6 |
| Honduras | 714 | 21.4 | 33.7 | 12.4 | 15.3 |
| Mexico | 1334 | 49.5 | 44.4 | 27.4 | 16.4 |
| Nicaragua | 2782 | 22.3 | 26.5 | 13.4 | 12.6 |
| India | 87 | 9.3 | 25.3 | 4.2 | 12.6 |
| Bangladesh | 115 | 23.2 | 17.1 | 6.4 | 5.6 |
| Thailand | 680 | 18.9 | 14.1 | 9.5 | 6.4 |
| Indonesia | 459 | 13.9 | 32.1 | 6.5 | 11.7 |
| China | 60 | 4.3 | 10.3 | 1.5 | 4.2 |
| Malaysia | 1044 | | 6.6 | | 2.4 |
| Philippines | 508 | 26.6 | 27.7 | 18.2 | 8.3 |

Source: World Bank (1994). World Development Report. Washington.

However, nowhere in the literature reviewed is there an analysis of the net foreign exchange earnings from shrimp culture - given that more intensive systems will require inputs often valued in foreign exchange, nor is there an analysis of the contribution shrimp export earnings have actually made to national economies. This is a glaring omission if it is seen as the main rationale and benefit of the industry.

Hopkins *et al.* (1995) identify a multinational benefit in the relief of pressure on the world's capture fisheries for shrimp, without which world stocks might have been decimated, with consequent economic losses to both producer and consumer countries.

Bye (1990) considers economic stimulation and infrastructural improvements in rural and backward areas to be one of the main economic benefits of aquaculture in Europe. Meltzoff and LiPuma (1986) show that shrimp culture in Ecuador has transformed the regional balance of the economy with respect to production, employment and habitation, and Liao (1995) cites the important role played by aquaculture in stabilising the rural coastal economy in Taiwan (Province of China) in the 1970's.

Community level benefits are seen as rural job creation and improved rural earnings, and making (apparently) unproductive and marginal land productive.

Boonchuwong (1994) cites a study in which relative incomes of different occupations in southern Thailand were estimated. After trading/small business (879,961 Baht/year), shrimp farming (316,693 Baht/year) ranks above orchard farming (188,216 Baht/year), artisanal fishing (69,544 Baht/year), rice farming (47,927 Baht/year), and labouring in the fishing industry (40,800 Baht/year). Unsurprisingly, many artisanal fishing families have turned to shrimp farming.

Strongly implicit in the literature reviewed, however, is that the main beneficiary of shrimp culture is the diverse group of people in each country that control the production process, and which may include large rural landowners, urban entrepreneurs, government officials, bankers and other socio-political *élite*. They are invariably seen in a pejorative sense, presumably because they are 'winners', and nowhere seem to be viewed as rational economic actors responding to prevailing opportunities and constraints. The benefit accruing to these groups is not acknowledged as such at all, which is rather a subjective view. It does in fact contribute to the generation of capital surplus and is thus potentially a source of funds for investment in other productive enterprises; a necessary component of economic growth.

Other major beneficiary groups that have been largely ignored in the literature until recently are consumers in first world markets and the trading companies that supply them. Consumers are interesting in that their demand (in the USA and Europe at least) has already proved sensitive to a number of environmental issues. Trading companies are interesting as they represent a concentration of market power. This key link in the market network has significant influence because both consumption and production are much more competitive in market structure, (e.g. Lockwood, 1997).

It has also been observed that little account has been taken of the input supply sector, which provides significant income and employment; a major benefit that needs to be accounted for in any overall analysis of the shrimp culture industry.

The literature has also ignored the international financial institutions with outstanding loans to shrimp producing countries, and countries with balance of payments surpluses with shrimp producing countries, the bills of both of which are met in foreign currency, partly earned through shrimp production. Current and future citizens of shrimp exporting countries therefore benefit from national debt reduction and the availability of imported goods.

It is perhaps surprising that the major beneficiaries of shrimp culture - representing the very forces that have directed the growth of the industry - have received little or no analytical attention in the literature.

Indeed, the literature seems to assume that the benefits of shrimp culture are sufficiently understood and well documented and/or are not important, and seeks to raise awareness of the problems and costs the industry has caused, and the distribution of these between different disadvantaged groups within society.

Only in an early paper by Kamphol and Thanwa (1982) was an attempt made to weigh up the net benefit or loss to society through shrimp farming, for the case of Thailand. They calculated a net social benefit and so recommended government support for development of the industry.

## 3. PROBLEMS ASSOCIATED WITH SHRIMP CULTURE

Shrimp culture (like any other economic activity) has a number of side-effects or problems associated with it (‘externalities' in economics). These side-effects may be positive (i.e. beneficial) or negative (i.e. problematic). A problematic side-effect represents a cost to somebody or group of people. An important distinction to make here is between those problematic side-effects that reflect back on the industry itself (‘negative feedback') and those that occur elsewhere. Those which reflect back on the industry itself will appear as a cost to private operators, who will thus make production decisions to avoid or minimise the problem and therefore the cost. Such costs are said to be ‘internalised' by the producer. However, those problems which do not feed back onto the producer, will impose a cost on other people which will not be reflected in the production decisions of the producer. These are called 'negative externalities', and are the subject of much of the literature.

It must also be mentioned that the shrimp culture industry itself has costs imposed on it by negative externalities from other economic and non-economic activities.

### 3.1 Technical problems and constraints

Technical problems cause negative feedback effects, which are dealt with by the industry over time. The more intensive the production regime, the more technical problems the producer is likely to face. It is interesting to note that the technical problems encountered change over the life-time of the industry as it expands and reaches new environmental limits which thus feedback negatively onto production.

The first environmental constraint encountered was the shortage that developed in many areas in the supply of post-larval shrimp with which to stock ponds, (e.g. Bailey 1988, Parks and Bonifaz 1994). PLS were caught in the wild then grown-out in ponds. The rapid expansion of the industry caused huge fishing pressure on wild stocks of PLS whilst, in many cases, simultaneously destroying the PLS environment by conversion of mangroves into ponds. Stocks inevitably dwindled and ponds were left unstocked and idle.

Once the 'free' supply of wild PLS became insufficient, in order for production to continue and continue to expand, a technical solution was found that added the cost of PLS supply explicitly into the production decisions of firms. The advent of hatchery technology has in many areas overcome this environmental constraint, and in the process, has created an important new industry with many economic benefits.

The next major environmental constraint encountered by intensive shrimp culture was the waste absorption capacity of the water bodies into which farm effluent was discharged and from which 'clean' water was often taken. Once the 'free' environmental services of 'waste sink' and 'clean water' were exhausted, the industry dramically came to face the associated negative feedback costs in the form of disease outbreaks and production crashes. This has in turn forced the industry to begin to make explicit consideration of the costs of these environmental services in their production decisions, either by siting new capacity with consideration of environmental capacity, and/or by more careful effluent water treatment and less water-intensive production systems.

The point is, that when production reaches an environmental constraint, the industry is forced to internalise costs that were previously external to production decisions - without the intervention of regulation. In cases where environmental damage is reversible (e.g. water quality will recover), this represents a second-best solution.

Barg (1992) and Liao *et al.* (1995) also reports that pollution from other sources can cause production problems in shrimp farms. This is a case of an external cost of production from another industry becoming a cost to shrimp producers.

### *Policy perspectives and recommendations*

The main technical problems faced by the industry result from production being viewed at a pond or farm level, with neither producers or planning authorities considering the effect of many ponds/farms all producing in the same area. It is clear that production capacity within particular areas must be considered in relation to the support services offered by the environment in those areas, so that environmental capacity is not exceeded.

Although such problems became dramatically apparent as early as 1988, regrettably, the lessons were not learnt and acted upon internationally. As a result, such environmental problems and associated production collapses have been experienced in most major shrimp culture countries, up to the present day. It is hoped that initiatives such as the current Technical Consultation and the formation of the Global Aquaculture Alliance (Rosenberry 1997c, Anon. 1997) will help to avert the replication of mistakes in the future.

There is clearly a role for planning authorities in demarcating shrimp production areas and limiting total production capacity in line with environmental criteria. There is also clearly a role for producers in particular areas to become organised so as to voluntarily manage production in that area for their own benefit. Producer organisations have an advantage over planning authorities in that they are in touch with production every day and in touch with the latest developments in production technology and management and so can adjust area management strategies more quickly. Producer organisations at area and national levels working together with planning and regulatory authorities could be most effective.

Now that many technical problems of shrimp production are known, and solutions are beginning to be found for existing productive capacity, the same problems should be averted in new productive capacity. Again, the planning and regulatory authorities and producer organisations both have a role to play.

The two key areas where improvements can be made are: i) zoning and siting of productive capacity, and ii) pond/farm level production management. Zoning and siting plans should be part of overall coastal zone planning at area and national level, and international level where coastal resources are shared between nations (e.g. Gulf of Fonseca, Central America). Pond/farm level management will also benefit from area and national level perspectives as production regimes differ geographically. There is a regulatory role for governments to play at pond/farm level, but the ability of governments to formulate and implement policy effectively differs widely and cannot be assumed. Self-regulation by the industry would be enlightened self-interest providing positive externalities for others.

### 3.2 Environmental problems and constraints

Environmental problems associated with shrimp culture are the most widely reported in the literature. However, different shrimp culture technologies have different environmental impacts: extensive systems requiring large land areas have contributed most to mangrove clearance, while intensive systems have contributed more to pollution problems, through high stocking densities and feed and chemical inputs. The problems in any one country, accordingly, reflect the balance of culture regimes in that country.

#### 3.2.1 *Land use change*

While various types of land-use change are associated with shrimp culture, the most widely reported is the conversion of mangrove forests into shrimp ponds, (Bailey 1988, Brigg and Funge-Smith 1994, DeWalt *et al.* 1996, Flaherty and Karnjanakesorn 1995, Folke and Kautsky 1992, Gujja and Finger-Stich 1996, Lassen 1997, Liao 1995, Macintosh and Phillips 1992, Meltzoff and LiPuma 1996, Phillips *et al.* 1993, Primavera 1993b and 1995, Stonich *et al.* 1997, Thai-Eng Chua *et al.* 1989, Webb-Vidal 1992).

However, it must be noted that shrimp pond construction is not the only destroyer of mangrove forests. Mangrove forests are also being depleted by a large number of other agents and for many different purposes. Therefore, the issue of mangrove destruction goes beyond the shrimp industry alone and must be dealt with, accordingly, as part of coastal zone management.

The key issue with mangroves is that while they have many values - including use values - and have been important components in the livelihoods of coastal people for a long time, a broad realisation of their value has only occurred during the two decades of rapid expansion of shrimp culture. Thus, effective legal and institutional frameworks have not been developed for their management within the context of developing market economies, neither have effective markets developed for the services which they offer. As Thai-Eng Chua *et al.* (1989) assert, the main reason mangrove forest is converted to shrimp ponds is because it is cheap land (the actual land price is negligible, although the cost of gaining concession to the land may be considerable).

Consequently, conversion of large areas of mangroves has imposed various costs on society: the loss of coastal protection from typhoons resulting in loss of life and property, loss of coastal productivity resulting in reduced livelihood support and income earning possibilities, loss of wildlife, reduced supply of PLS, loss of capture fishery stocks as mangroves are nursery grounds, and ultimately, loss of shrimp cultivation itself as mangrove soils acidify.

Primavera (1995) derives estimates for the value of mangrove systems ranging from US$ 30 - 2000 ha./yr., with a maximum of US$ 11,561 ha./yr., for sustainable wood harvest in Malaysia. Fuller treatment of the value of mangroves is found in Dixon and Lal (1994) and Hamilton *et al.* (1989).

The other major land conversion has been that of rice paddies and other agricultural land to shrimp ponds. The environmental aspect of this centres on whether such conversion is reversible, or whether, once shrimp production has finished (often in very few years), the land will be unable to support any natural or agricultural productivity.

Construction of ponds and associated dykes, polders and access roads have also changed the hydrology of the land, causing flooding in some areas and the disappearance of seasonal lagoons in others. Overuse of aquifers in Taiwan (Province of China) caused land subsidence and flooding.

A further effect of the large area of land now committed to shrimp culture, is that the remaining coastal land - whether mangrove forest or agricultural land - tends to come under further pressure, with the consequent increased threat of unsustainable use of the resources.

#### 3.2.2 *Pollution*

The polluting effects of shrimp culture are the other major concern of the literature (Anon. 1991b, Barg 1992, Brigg and Funge-Smith 1994, DeWalt *et al.* 1996, Flaherty and Karnjanakesorn 1995, Liao 1995, MacIntosh and Phillips 1992, 1996, Mahmood *et al.* 1994, Muluk and Bailey 1996, Niemeier 1990, Patel 1996, Phillips *et al.* 1993, Primavera 1994, Smith 1993, Thai-Eng Chua *et al.* 1989)

Intensive shrimp farms pollute surrounding water bodies by discharge of effluent from ponds. This impacts on other users of the water body, including extensive shrimp farms, and even back on the polluting farms themselves.

Salinisation and pollution of agricultural lands - especially rice paddies - by seepage, discharge and inundation has ruined crops and rendered land unsuitable for agriculture.

Salinisation of fresh water supplies in lakes and aquifers has reduced drinking water quality.

Uncontrolled use of chemicals has led to toxicity in non-target species and in some marketed products.

Waterborne diseases, especially of the skin, have been reported in some areas.

### 3.2.3 *Ecology*

Ecological issues reported include possible species composition and biodiversity impacts through habitat destruction and destruction of wild fry stocks, and alteration of gene pools through introduction of exotic species.

Larsson *et al.* (1994) provide an illuminating ecological perspective on shrimp farming, and conclude that it is one of the most resource intensive food production systems. They develop the concept of an 'ecological footprint' - the total area required to support production on the basis of supply of inputs - and find that semi-intensive shrimp cultivation requires a 'footprint' of between 35-190 times the size of the pond area. It is thus understandable how high concentrations of shrimp farms have lead to environmental problems. This is important work both for resource allocation decisions, and for pond site planning.

### 3.2.4 *Environmental problems faced by shrimp culture*

Environmental problems suffered by, yet not created by, the shrimp industry have been cited by several authors (Anon. 1991a, Colburn 1997, DeWalt *et al.* 1996, Liao 1995, Stonich *et al.* 1997, Thai-Eng Chua *et al.* 1989) They include: mis-use and run-off of agricultural pesticides and fertilisers; sedimentation of canals and water inlets through soil erosion in upland areas due to deforestation and inappropriate agricultural practices; pollution of water sources through sewage from urban areas and industrial effluent - especially heavy metals, oil spills, and red tides of toxic algae.

#### *Policy perspectives and recommendations*

The environmental problems associated with shrimp culture are all externalities of production. They arise because markets do not exist for certain aspects of the environment. In turn, markets do not exist due to a confusion over, lack of, or the inability to enforce property rights for aspects of the environment.

The key to resolving environmental problems, therefore, is the determination of values for aspects of the environment, and the establishment of mechanisms through which those values can be included in private production decisions and public planning decisions.

While methodologies exist for placing values on the environment (e.g. Barbier, 1993), few such studies appear in the shrimp culture literature. In addition, there appears to be almost a complete absence of studies on mechanisms for including environmental values in planning and production decisions (e.g. Soley *et al.* 1994). There is considerable advantage in having impartial, expert studies on all the environmental dimensions of shrimp culture.

A further key issue for environmental policy is how to deal with abandoned shrimp ponds. Gujja and Finger-Stich (1996) estimate that about 15,000 hectares of ponds were abandoned by the top four producing countries in 1994 alone. The problem is only going to increase with further disease outbreaks and as world production capacity adjusts to demand. While some natural regeneration of mangroves will take place, and ex-agricultural land may eventually recover productivity, considerable effort and finance will be needed if these degraded areas are to be returned to pre-shrimp productivity levels in a reasonable time. It is interesting to speculate here as to the extent to which the shrimp producers and the shrimp consuming countries might be willing to finance this undertaking.

### 3.3 Economic problems and constraints

The key economic problem facing producers is the decline in the world price (Anon. 1991a, Lee 1995, Niemeier 1990, Phillips *et al.* 1993, Primavera 1993b, Thai-Eng Chua *et al.* 1989). Kei-chai Chong (1992) highlights the cost-price squeeze facing the industry: prices are falling as world supply expands faster than world demand, and costs are rising as demand for inputs is expanding faster than supply. Thus the main economic problem simply reflects one of markets giving price signals within a process of adjustment to equilibrium.

As with any other rapidly expanding industry, there will be a period of expansion marked by abnormal profits followed by a period of contraction marked by declining profits in which only the most efficient operators (be they firms or countries) will remain in production. The result in time will be an industry characterised by balanced growth of supply and demand, and by efficient production.

For some producers, the struggle to survive under fluctuating market conditions, may in part reflect a lack of good investment appraisal by the industry. Good investment appraisal with sensitivity analysis would show up the key factors in profitable production under any particular production regime, and together with informed views about likely future values of those factors (e.g. farm-gate price, feed price etc.) would allow a realistic assessment to be made of the likely performance of the investment under fluctuating conditions (e.g. Griffen 1995).

***Policy perspectives and recommendations***

International market demand and price are clearly factors outside the influence of any one shrimp producing nation (they are exogenous).

What governments do have influence over is the fiscal environment in which shrimp culture investments take place. The overall balance of tax and subsidy regimes will effect the type and size of industry that develops, and will thus impact on all the other issues raised in this paper (e.g. Hecht, 1985). Unfortunately, no such studies appear in the literature reviewed; a major omission.

Investment appraisal is another aspect of shrimp culture that receives little attention in the literature reviewed, perhaps because it is thought to be a matter for private producers only. It appears the bias is still on technical aspects of production. This is of concern both to the investor and to the planning and regulatory authorities. To the investor it can lead to wrong investment decisions with regard to shrimp *vis-à-vis* other possible investments and with regard to scale, siting, and production regime. For the planning and regulatory authorities it can lead to wrong investment decisions, due especially to investment lifetimes being unrealistically short (Flaherty and Karnjanakesorn 1995).

Though not explicitly stated in the literature reviewed, it appears that the chief criteria of investment appraisal is still the pay-back time of the investment. This is incorrect from an investors' point of view, but also can have serious environmental effects as farms can be abandoned after initial pay-back. Discounted cash flow methods, especially Net Present Value should be used together with stipulated investment lives of a much longer duration than often seems to be the case. It would be of great assistance here if shrimp investments were tied to land concessions of longer duration, allowing the possibility for sustainable management of environmental resources to be more profitable than 'mining' and abandonment.

At a national level, economic and social appraisals (cost-benefit analyses) of shrimp culture should also be conducted, as the national economy and society face costs that do not confront investors e.g. the true cost of mangrove conversion in terms of value foregone (e.g. Gammage 1997). Such economic and social appraisals should inform decisions at national and area levels about appropriate uses of coastal areas amongst competing uses.

The wider general literature on investment appraisal and economic and social cost benefit analysis is well developed, but the shrimp industry may benefit greatly from the availability of guidelines and studies specific to the industry. If as much effort had been put into getting private and public investment decisions right as has been put into getting production regimes right, many of the industry's problems may have been averted. Where national capacity exists, it should be made a requirement of the investment authorisation procedure that new investments submit an investment appraisal of a particular type, to make both the investor and the authorities explicitly consider key issues.

### 3.4 Social problems and constraints

The key social themes in the literature are: the marginalisation of the rural poor, their increasing landlessness, breakdown of traditional livelihood support systems, increasing poverty, diminishing food security, and the transfer of land and wealth to local and national *élites*.

There are several specific mechanisms through which shrimp culture has adverse social effects.

Where mangroves are converted to shrimp ponds, communal land with multi-purpose use becomes converted to private land for single purpose use, owned by whoever has the political and economic capital to gain the land concession from the government (though the price paid for the actual title is negligible). (Bailey 1988, DeWalt, Verge and Hardin 1996, Mahmood *et al.* 1994, Muluk and Bailey 1996, Stonich *et al.* 1997, Stonich 1995, Webb-Vidal 1992,.) Thus the livelihood support derived by the community is lost. One result of this is that utilisation pressure on remaining mangrove resources is intensified and can become unsustainable. The livelihood problem then occurs if shrimp production does not replace own-production livelihood activities with employment opportunities. This may be so as neither extensive nor intensive shrimp production are labour intensive, and jobs created are often for outsiders. While thousands of often seasonal jobs have been created, mainly in the harvest of wild PLS, this economic activity is not in itself sustainable and impacts on the livelihood of others. The choice of production technology is important here to help minimise social costs, and can potentially be influenced by government fiscal policies.

Many shrimp ponds have been constructed on ex-agricultural land, especially rice paddy. Here, although land is often privately held, a transfer of land-use (if not ownership) has occurred from the former small-scale farmers to larger private shrimp farming concerns. The means of transfer reported have covered: legal sale of deed, forced sale through harassment, sale following degradation of the land by shrimp farm pollution, and sale after inundating and ruining the land with salt water, and evictions of tenants. The effects are much the same as for mangroves - an established livelihood support system is broken down as land with multiple agricultural uses is turned over to monocrop production.

Common to both these types of land conversion are the following results: rural peasants become detached from reliance on the land and are effectively made available to the wage labour market, food production (and other products) for own-consumption and local markets declines, food security worsens as livelihoods become more dependent on both the market for shrimps and the market for foodstuffs - the actions of both of which are outside the control of the rural population, changes in land-use and ownership lead to conflict - sometimes violent - between dispossessed groups and new capitalist owners.

Pearse (1980, p.159) identifies exactly the same process in reference to the Green revolution,

> **"The implications of increased dependence of the locality upon the urban-industrial network is an aspect of social change that leads in several directions. It biases the distribution of advantage in favour of those who have the experience and social attributes necessary for confronting the city and the bureaucracy, the printed instructions, and the political caucuses; and it puts a relative handicap on those whose assets include traditional knowledge of the local idiosyncrasies of soil and climate, and whose energies are absorbed by the labours of husbandry rather than in manipulating the rural-urban nexus".**

Datta (1995) details some of the livelihood costs of shrimp pond expansion in Bangladesh in terms of lost productive opportunities of families: rearing poultry and livestock, growing fruit trees, kitchen gardening, culturing fish in homestead ponds, availability of cow dung and wood for fuel, availability of milk, access to fresh drinking water, loss of draft power for tilling, threshing and transport, loss of paddy, jute, mungbean, sesame and pumpkin.

What is happening is the incorporation of the rural economy into the national and international market economy. Whereas before, peasants worked on the land to which they had use rights to produce food and a livelihood for their family, they are now denied use of land and have to enter the national market economy as wage labourers in order to buy food and other livelihood requirements in the market. The point to make here is not that one system is intrinsically any better or worse than the other, but that during the process of economic and social transformation, the rural population tend to lose one livelihood without finding another one.

Again quoting Pearse on the Green Revolution (Pearse, 1980, p. 157),

> **"In unequal societies the new technology can facilitate 'take off' for cultivators with land and some capital but institutes changes that marginalise the small cultivators without capital and land and undermine the essential and customary means of livelihood of an ever-increasing number of people in rural areas".**

While one potential solution to these problems is for community involvement in production through small-scale co-operatives, Cruz Torres (1996) reports on some of the difficulties of this for two communities in Mexico, and DeWalt, Verge and Hardin (1996) report that while initial development documents for Honduras supported this approach, later documents have stressed that only large-scale farming is economically viable. Twenty five large companies now dominate shrimp production in Honduras. Tokrisna and Benheam (1995) report that it was the larger farms in their study in southern Thailand that proved the most profitable in the longer run, due to scale economies and better management; the small-scale farms going out of business after initial profitability.

However, Niemeier (1990) reports how a large, vertically integrated, private shrimp company in Thailand contracts out the actual production process itself and effectively acts as an extension agent to local farmers, by providing technical know-how, capital, inputs and marketing, leading to increased farmer incomes with retention of land ownership. It is probably the large corporate investors in shrimp culture who are best placed to implement imaginative production schemes which lessen the social impact of shrimp farming and provide examples of 'best practice', while increasing long-term profitability of production. It is regrettable that the literature has not sought to explore such possibilities.

The social problems are strongly associated with the system of property and use rights existing in a country or area. In mangrove areas, governments - as *de facto* owners of the coastal lands - can award concessions to entrepreneurs with social, political and financial capital without regard to existing use patterns by local communities, as these are rarely validated by communal or private ownership title. However, where agricultural land has been owned, small-scale landowners have been willing to sell their land and reinvest in other productive activities, though this change of livelihood can also lead to social dislocation and reduced livelihood support.

### *Policy perspectives and recommendations*

The social problems documented in the literature reflect a larger pattern of change and in general are not peculiar to the shrimp industry alone. In particular, they are reminiscent of problems encountered during the Green Revolution: in which respect, it appears little has been learnt from that episode. More generally, they are the problems associated with enclosure of commons, capital intensification of production, and market-led production of monocrops, such as was witnessed in the clearing of the Scottish Highlands in the 18th century for the promotion of sheep farming for the English market (e.g. Prebble, 1969) and the enclosure of the common lands in England from the 17th century onwards (e.g. Rule 1992, chap 2).

This does not deny or lessen the human cost involved in the economic transformation, it merely serves to put it in context, and locate the cause for the human cost in the wider system and in economic dynamics rather than in the industry itself. According to Pearse (1980, p.173),

> **"Economic growth or 'development' by a capitalist penetration of the prime zones of production and incorporation in the international economy appear to carry with them a dynamic poverty-generating principle unless the process can be understood and the political will is present to inspire governments to counteract economic polarisation"**

The social problems also reflect the prevailing power relations in a country and so are again symptoms of a larger problem and not specific to the shrimp industry itself. It is only through change in the economic, legal, social and political parameters of power in a country that real social progress can be made. This requires the "political will" of those groups who most benefit from the existing power relations within a country and who may also be amongst the major beneficiaries of a country's shrimp culture industry.

Leftwich (1993) has examined approaches to promote effective development, and indicates that,

> **"... strategies will need to include far reaching programmes of economic empowerment in order to bring the economically marginalised more fully into productive economic activity. The means for this will vary widely, but will include land reform, such as occurred in Korea, the extension of property rights, training, job creation and imaginative forms of credit."**

### 3.5 Legal and institutional problems and constraints

Legal problems and constraints fall into two categories: i) confusion over the legal and institutional position of aquaculture, and ii) enforcement problems of existing laws. The first problem exacerbates the second.

Authors writing about Europe, Asia and Latin America have all identified that coastal aquaculture has no clear legal or institutional position (Anon. 1997, Bye 1990, Flaherty and Karnjanakesorn 1995, Mathew 1993, Meltzoff and LiPuma 1986, Primavera 1994, Samudra 1997, Stephen *et al.* 1993, Webb-Vidal 1992). Located on the coast, growing aquatic organisms that are otherwise harvested in capture fisheries, but with methods more akin to intensive agriculture, aquaculture does not fall neatly into either fisheries legislation or agricultural legislation (nor industrial). It is frequently administered by both, together with a host of other different institutions depending on the country in question.

What appears to be the case, is that the recent development of large scale/intensive aquaculture has created the need for new legal and institutional arrangements. So far, such arrangements have not been put in place. What appears to at the heart of the problem is a clear perception of what aquaculture is; what is its nature. And here, Bye (1990) is instructive,

> **"Aquaculture is a food producing business differing from conventional agriculture only in using as a growing medium water rather than soil. It is often treated as an industrial process although even at its most sophisticated it is no more so than is the intensive culture of pigs or poultry. As an essentially benign agricultural activity the laws and regulations concerning aquaculture should be of the same type and extent as those covering farming and not of the kind appropriate to potentially hazardous industrial activities, as they often are."**

He recommends,

> **"A new body of law must be created, which replaces this existing framework with legislation designed to serve explicit policies which allow the industry to expand but protect the broader public interest. Regulation....should be appropriate to the agriculture industry of which aquaculture is a part."**

The literature reviewed seems consistent in implying that, to date, shrimp culture development has taken place in a vacuum of planning and regulation, or, where planning and regulatory measures have existed, they have either been inadequate, been circumvented, or simply ignored. It is not surprising therefore that during its rapid growth the industry has faced such widely reported internal problems and external criticism.

Several authors argue for some form of coastal management (, Barg 1992, Bye 1990, Stephen *et al.* 1993, Thai-Eng Chua *et al.* 1989). Key issues include the need for co-ordination between shrimp culture and other users of the coastal zone, and for a single agency to administer the zone with full responsibility for aquaculture. However, both Flaherty and Karnjanakesorn (1995) and Meltzoff and LiPuma (1986) are pessimistic about governments' ability to enforce planning measures even where they exist, the former advocating instead, extension work to educate farmers and public investment in water supply infrastructure.

The recent Supreme Court ruling in India with respect to shrimp culture requires the constitution of a National Coastal Management Authority. Its main objective will be to safeguard marine life and coastal areas. It will represent one legal institution to which shrimp farming will answerable, instead of the plethora of institutions involved previously (Anon. 1997, Mohan 1997, Patel 1996, Samudra 1997.)

In several shrimp farming countries, the problem is not a lack of legislation - especially environmental legislation - but an unwillingness or inability to enforce it.

Effective enforcement of existing laws and creation of new laws capable of regulating the shrimp culture industry may founder for a variety of reasons. For example, lack of manpower and other resources; and, overlapping and unclear jurisdictions of government departments with respect to aquaculture.

However, Samudra (1997) notes that the Supreme Court judgement in India issued from a petition under article 32 of the Constitution of India (in the public interest) to enforce previous legislation - the Coastal Zone Regulations Notification of 1991. The extent to which the ruling of December 1996 has itself been enforced is not yet reflected in the literature.

What does seem apparent from the literature reviewed, is that the fundamental requirement for existing laws to be enforced or for new laws to be made, is that the people who are adversely affected by shrimp culture development become organised so as to initiate public debate and gain communal political strength to compete with the powerful interests of the shrimp producers. As Leftwich (1993) states,

> **"...contestation about the nature and direction of economic development, the distribution of the costs and benefits of transformation, the institutional forms of government and the character of the state appropriate to this, is contestation about power. Hence, it is not simply a managerial question..... but a political one. For all processes of 'development' express crucially the central core of politics: conflict, negotiation and co-operation over the use, production and distribution of resources."**

### 3.5.1 *Organised lobbying and conflict resolution*

Samudra (1997) in reporting on the Indian Supreme Court ruling, wrote that shrimp farming

> **"...has been challenged by the ultimate arbiters of the public good, the people themselves, who embarked on a campaign of protests. Several networks of NGO's, fishing communities and environmental activists were formed. Demonstrations, fasts and strikes were undertaken".**

The petition to the Supreme Court was made by the leader of an Indian NGO, and led to the most pro-environment, anti-shrimp culture ruling yet seen.

Meltzoff and LiPuma (1986) on the other hand, report that in Ecuador, where the shrimp culture industry was a well established and very important part of the national economy, that the working class - 25% of which had become directly dependent on shrimp culture - were vociferous and volatile in resisting any management or legal changes that may lead to reduced job opportunities and incomes. In this case, the government was caught between avoiding this short-term threat to stability and ensuring the continued survival of an industry on which the country had become heavily dependent.

What these two contradictory examples clearly illustrate is, that whether the rural population are arguing for or against the shrimp industry, their wants are only addressed if they have an effective voice and political presence.

Sebastiani *et al.* (1994) - describe a case in Venezuela, where construction work on a shrimp farm caused protests from local fishermen, due to the adverse impact which the siting of the farm would have on their traditional natural resource base. Official complaints were made to the authorising Ministry of Natural Resources who took action to stop construction of the farm and later to change laws and procedures so that such mistakes could not happen again. Crucial to the success of the fishermen's complaint were: i) they were already organised into a large fishermen's association, ii) access to the national press who were able to make it a national issue, iii) support of the Audubon Society of Venezuela, an NGO interested in bird populations, iv) a government ministry which was willing to listen, v) supportive environmental legislation. The case they describe of Venezuela seems an exemplary one: environmental impact assessments are a requirement for construction licenses, they are public documents, have established guidelines, and now have an auditing programme and agency set up to enforce compliance with approved EIA's by all shrimp farm development projects. The whole process is backed by penal law.

Stonich *et al.* (1997) find hope for achieving sustainable shrimp culture development in (amongst other reasons): the emergence of grassroots movements amongst the poor who have lost out to shrimp farming, a move to community participatory developments by international groups, and in environmental groups taking up the issues and formation of new groups, such as Mangrove Action Plan.

### *Policy perspectives and recommendations*

The literature reviewed seems clear in proposing the creation of single institutions with power over development in the coastal zone as a key requirement for all countries, to ensure development of a shrimp industry in which all interests are fairly represented (for a discussion in relation to temperate countries, see Neiland and Nowell, 1991) However, creation of such an institution in many countries is likely to be resisted by those institutions and other interests who fear they may lose out in such a move. Also, it must be considered that creation of such institutions in countries without a general level of 'good government', may merely concentrate power and so worsen, not improve the situation. As Meltzoff and LiPuma

(1986) warn, any policy solutions should be based on clear analysis of the situation pertaining in the country in question, especially with regard to power relations within that country.

The extent to which views of marginalised rural populations may form part of government policy depends in the first place on the nature of the government. A socially concerned government may take steps to make participatory approaches to rural investment a requirement of investment licensing.

Pearse (1980, p.208/9) is again instructive,

> **"Governments are dependent on the social groups that support them...they respond to the desires and interests of their different support groups in the measure that these have real power to influence the making and implementation of political decisions.....the overriding aim of all governments must be to maintain the power of the groups upon which they depend for their support. All policy goals and means are subordinated to this constraint. It is not surprising, therefore, to find that even when laws embodying socially desirable legislation are passed, they are likely to be aborted in practice, or nullified by counterposed measures, if they are contrary to the interests of the supporting groups."**

## 5. CONCLUSIONS

The review process which has been undertaken has shown up a number of important gaps in the literature. In particular, there is a lack of independent analysis of the major benefits and beneficiary groups of shrimp culture (private producers, traders, first-world consumers) and of the market-based incentives they face and create.

This in turn may arise from perceived biases in the literature, which tends to see all rural people as 'victimised' and 'losers', all producers as ruthlessly exploitative 'winners', and governments as willing accomplices to producers. This tendency to polarisation only leads to conflict. It would be more beneficial if all interested parties were seen as potentially having a constructive input to make to policy formation. In particular, it would be beneficial to co-opt private producers and traders and their respective organisations into the development and policy process rather than vilifying and fighting them. Realistic and constructive approaches that take account of the problems and constraints discussed in this paper are to be encouraged.

The literature review process also showed up the need for the shrimp culture industry to be viewed - and to view itself - in a wider perspective, to facilitate clearer analysis of problems and so formation of correct policy responses. The policy process should try to incorporate all of the issue areas raised in this paper.

Although it is argued that many problems in the industry are symptoms of wider processes, for both producers and national governments to abdicate responsibility on that premise would be a short-sighted mistake. The key to long-term, sustainable profitability of the industry providing benefits for all, is to openly acknowledge and act upon the whole gamut of problems presented above. In this respect, it would be enlightened self-interest on behalf of producers and governments to re-invest part of the profits from shrimp culture directly into solving the industry's problems. If the major beneficiaries of shrimp culture do not willingly incorporate the external costs into production decisions, those costs will eventually be forced upon them. To allow this to happen in the shrimp culture industry risks killing off an industry with exceptional possibilities for benefiting all in tropical countries.

**Appendix 1**

## OVERVIEW AND ASSESSMENT OF THE LITERATURE

### Introduction

Whilst this review has been subject to constraints of time and budget, considerable efforts have been made to retrieve and scan the relevant world literature, including the grey literature and information available in electronic form via the Internet/World Wide Web and it is apparent that there currently exists a large and extensive international literature base on shrimp culture. As part of the process of producing a review of the literature which would, for the first time, include multi-disciplinary information, bibliographic research and analysis were undertaken. The objective was to provide an assessment of the coverage of the literature assembled in terms of subject coverage, publication type, and geographical area.

### Methodology

Library and information specialists at the FAO Fisheries Library in Rome, and at the Centre for the Economics and Management of Aquatic Resources (CEMARE) searched a wide range of bibliographic sources including:

*Aquatic Sciences and Fisheries Abstracts* (ASFA), 1978-June 1997
*Aquatic Biology, Aquaculture and Fisheries Research*(ABAFR) 1985-June 1997
*ISI Current Contents (Agbio),* 1996-97
*ISI Current Contents (Social)* 1996
*Econlit* (Economics) 1969-September 1997
*ABI/Inform* (Business) 1994-97
*Applied Social Sciences Index and Abstracts* (Social Policy)
*Sociofile* (Sociology)
CEMARE Fishecon and Fishext Databases
FAO Fishery Library Catalogue
CEMARE Library Catalogue
A variety of sites on the Internet/World Wide Web.

In addition, the specialised collections held in the CEMARE Library provided valuable material, as did the serial collections of the University of Portsmouth Library.

Searching such a broad range of sources was deemed necessary because of the cross-disciplinary nature of the Consultation. Separate search strategies were constructed for each database, and refinements and adjustments were made as the searches progressed. The searches concentrated on retrieving literature on policy issues, socio-economic aspects, environmental impact, sustainable culture and conflicts, as well as general reviews and bibliographies. Problems arose in relation to the indexing protocols of some of the databases, especially those with a biological bias, in that very often shrimp and prawn literature is all indexed as shrimp, and the term socio-economics is either not used, or is a relatively new indexing term. In these cases title and abstract fields were also searched, and alternative search terms were used. The largest proportion of references were obtained from the ASFA, ABAFR and CEMARE databases, but the additional references retrieved from other sources, especially the social science, management and business databases, added important perspectives to the review.

The results of all the searches were combined into a specially created database, duplicate and inappropriate records were deleted, and references assembled for review. The most relevant publications were selected, obtained and examined, as a result of which further sources in the literature were found. Whilst the total number of references assembled and included on the database amounted to c.600, due mainly to the constraint of time, only those deemed to be most relevant were selected for review. Inevitably there was a bias towards documents in the English language, or containing an abstract in English. The publications reviewed comprised, in the most part, more formal publications such as journal articles, books, conference papers/proceedings and scientific reports. It should also be noted that due to the long lead time on academic publications, even the most recently published literature deals with not later than the year 1995, thus apart from newsletter reports, up-to-date events in the shrimp industry are under-represented.

Results of the bibliographic analysis

The literature contained in the whole database was subsequently analysed by subject coverage, publications type and geographic area, and the results of this analysis are presented in Table 2 (above).

***Table 2. Results of bibliographic analysis***

| **Focus** | **Categories** | **%** | **Focus** | **Categories** | **%** | **Focus** | **Categories** | **%** |
|---|---|---|---|---|---|---|---|---|
| **Subjects** | General | 39 | **Publication Type** | Journals | 33 | **Geography** | General | 35 |
| | Environment | 18 | | Book | 4 | | Asia | 41 |
| | Economic | 11 | | Conference proceedings | 33 | | Central and S. America | 14 |
| | Social | | | Report | 18 | | Australia and Pacific | 3 |
| | Technical | 22 | | Others | 12 | | Africa | 2 |
| | Institutional, legal and policy | 3 | | | | | | 5 |
| | TOTAL | 100 | | TOTAL | 100 | | TOTAL | 00 |

**Assessment**

A number of key findings have emerged from the assessment of the literature:

(i) In terms of subject areas, the literature is dominated by publications of a non-specific or general nature. The main content of this literature focuses on technical and environmental aspects of shrimp culture, with a superficial treatment of other areas including, for example, economic and social matters.

There is in general a lack of balanced assessments, which consider the interests of the various parties involved in the industry (producers, governments, rural population) and which highlights areas in which mutual progress might be made. Indeed, the interests and contributions of producers seem resolutely ignored. On the other hand, while the plight of various groups of the rural population are lamented, few realistic recommendations are made as to how this situation can be improved. While both pro-industry and anti-industry both have their respective literatures, independent and open-minded views drawing on both do not seem to exist.

Also largely absent from the literature are studies that weigh up the problems and costs of shrimp culture against the benefits. Socio-economists are well positioned for such work, but their contribution to the literature seems inadequate to date.

Anthropological views, while represented in the literature, could benefit from wider application, as the contribution they make in institutional analysis is essential for a full understanding of the issues involved.

The majority of the literature reviewed was specifically about shrimp culture, and so mainly concerned tropical countries. Rarely was shrimp culture in the tropics considered in the context of aquaculture in general and aquacultural developments in other parts of the world and involving other species. For example, many of the issues reported in the literature have direct parallels within farming of salmonids in northern Europe. The management and development of the industry could benefit from lessons learnt elsewhere.

(ii) In terms of publication type, the literature on shrimp culture is dominated by articles in academic journals and conference proceedings. Most of these publications are characterised by being objective and widely available through international bibliographic sources. Publications and reports originating from industry were more difficult to access. It is worth mentioning that the publications produced by Rosenberry (San Diego) provide a continuous record of the shrimp sector over the last 20 years.

(iii) In terms of geographical coverage, the literature is dominated by publications from the major producing regions - Asia and S. America.

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# POLICIES FOR SUSTAINABLE SHRIMP CULTURE

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## SHRIMP CULTURE DEVELOPMENT : QUO VADIS

- UNDERSTANDING THE DEVELOPMENT HISTORY
- CONFLICTING VIEWS ON SHRIMP CULTURE DEVELOPMENT
- CHALLENGES TO SUSTAINABLE DEVELOPMENT
- NEEDS FOR ACTIONS
- CONCLUSIONS

## DEVELOPMENTAL HISTORY OF SHRIMP CULTURE

***Understanding the developmental history of shrimp culture will help us to make wise decision pertaining to its future development. Shrimp is a common but valuable fish resource with increasing market demand especially with improvement of standard of living and expansion of the tourism industry. A kilogram of shrimps is about half the cost of a barrel of crude oil today.***

- relatively short developmental history compared with finfish, oysters and mussels
- started as trapping and stocking in diked mangrove swamps and milkfish ponds
- before 50s, most farming operation based on trapping
- by 60s, stocking of wild seeds in diked mangrove swamps and fish ponds
- no feeding, low stocking rate, little farm management;
- by 70s, success in completing life cycle of some species; fry production successful
- stocking include pond raised fry and wild fry
- mangrove extensively used, habitats damaged;
- by 80s, semi-intensive rapidly transformed into intensive farming techniques
- high stocking rate and artificial feeds
- disease outbreaks reported since then
- major destruction of mangrove habitats
- by 90s many intensive shrimp farms collapsed, severe self-pollution reported

## FACTORS AFFECTING SUSTAINABLE DEVELOPMENT OF SHRIMP CULTURE

***The sustainability of shrimp culture enterprise depends on the combined effects of two sets of factors—intrinsic and extrinsic. They affect the culture operation, marketability of products, distribution of economic and social benefits, and the functional integrity of the resource system.***

## MAIN INTRINSIC FACTORS

- water quality
- culture techniques
- location and operation of facilities
- seed supply
- species characteristics
- availability of feeds

The intrinsic factors may be addressed through adequate on-farm planning and management which reduce the adverse impacts on the environment and sustainable production targets. Most of the environmental problems arising can be addressed within the enterprise i.e. the fish growers and the supporting industries.

## MAIN EXTRINSIC FACTORS

- national policy
- natural hazards
- climate change
- pollution
- market
- exotic species
- socioeconomic
- legislative control

The off-farm factors require appropriate governmental policy and management interventions, in terms of resource or area allocation, land-and water use planning, technical assistance, information services, legislative controls and coordination with other related industries.

The combined effects of intrinsic and extrinsic factors make it necessary to manage shrimp farming as an integral part of the whole resource system on which it relies.

## CONFLICTING VIEWS ON SHRIMP CULTURE DEVELOPM ENT

- ***Shrimp culture have been blamed for causing environmental degradation ( e.g. destruction of mangrove habitats, underground water depletion, salt intrusion, chemical pollution, converting fish to shrimp feeds).***

- ***Disparity in the sharing of the benefits of shrimp culture fueled by the often disease outbreaks spark off debates whether shrimp culture should be encouraged.***

- ***There are suggestions, especially in the developed nations to buy shrimps only if the products are produced from sustainable and environmentally friendly production system. On the other hand, the lucrative foreign exchange earning and employment generation opportunity provide justification to continue the culture operation in developing nations.***

## SUSTAINABLE DEVELOPMENT CHALLENGES

- expansion of multi-sectoral economic development towards the 21st century
- population expansion
- carrying capacity of the coastal and marine ecosystems
- self pollution

## STATE OF HABITATS DESTRUCTION IN THE EAST ASIAN SEAS

(Slide available)

## ECONOMIC DEVELOPMENT AND CARRYING CAPACITY

(Slide available)

## POPULATION GROWTH AND ENVIRONMENTAL STRESS

(slide available)

## ACTIONS NEEDED

Apply Integrated Coastal Management framework and processes
Create policy environment
Develop and manage aquaculture zone
Determine carrying capacity

Determine regulatory requirements and administer legislative responses
Undertake shrimp research

## Integrated Coastal Management ( ICM)

***ICM is a natural resource and environment management system which includes a generic management framework and planning and implementing processes that best integrate into the normal planning and management functions of the local governments.***

1. an institutional mechanism for interagency & intersectoral consultation and policy decision
2. a strategic management plan and specific action programme including a zoning scheme
3. an environmental monitoring mechanism
4. a law enforcing mechanism
5. a sustainable financing mechanism

## Policy Environment

It is essential to create a policy environment that :

- enhance the willingness and cooperation of the industry and the shrimp farmers to undertake measures to reduce self-pollution
- encourage local governments to undertake adequate aquaculture development planning and management including shrimp culture
- promote the development of appropriate legislation and efficient law enforcement

## National Aquaculture Policy

- ***A national policy on aquaculture reflects the government's commitment and support to a long-term development of the industry especially with respect to shrimp culture. Such a policy environment will strengthen the industry's willingness and cooperation in ensuring a healthy culture for their long-term investment.***

- ***A favourable policy environment provides substantive guidance on environmental protection and environmental legislation as well as economic incentives for development. The industries must be convinced of the long-term gains for compliance and the penalties for noncompliance with the government regulation***

- **The national aquaculture policy should form a part of the general coastal policy.**

    - remove or reduce the general perception and attitude of investors that shrimp farming is for profit,

    - avoid shot-gun approach of the investor and the policy makers

    - improve collective responsibility ( including small shrimp farmers) to ensure a healthy culture environment

    - involve the local government , the ngos and the stakeholders in environmental planning and management

## Aquaculture Zone and Management

***Establishing aquaculture zones within the overall national and local Coastal zoning Scheme is one effective way of minimizing use conflicts and protecting the life-support systems by delineating areas with functional advantages ( ecological and socioeconomical ) for various forms of aquaculture development.***

***A aquaculture zone should be adequately managed in order to obtain maximal benefits***

- systematic development of the allocated areas
- undertake remedial actions to improve farm management of existing practices
- application of cooperatives or contract system
- undertaken water quality control and management including pollution and product quality monitoring

- integrated environmental impact assessment
- financing the management of the aquaculture zones

## Carrying Capacity

- *The types and intensity of farming operations depend on the environmental's capacity either to supply the natural feeds and natural seeds or to flush waste materials away from the culture site. Even in intensive shrimp culture operation, the ability of the environment to absorb waste discharge will also limit the size of farm operation in a given area.*

- *The impacts of other human activities should be included in assessing environmental carrying capacity*

## Regulatory Requirements and Legislative Responses

***Regulatory controls are necessary measures to maintain the harmonious use of natural resources for sustainable development within and outside the industry. For a sound aquaculture development , diverse legal responses to various activities should be coordinated through a specialized legislative framework in order to***

- provide an opportunity for the development of the industry within the designated zones;
- protect and preserve the environmental quality of the designated zones
- control the carrying capacity of the designated zones in terms of types of species, culture systems, and level of operation
- provide economic incentives and disincentives for monitoring compliance or efforts to reduce self-pollution
- control the introduction of exotic species
- establish the financial mechanism for environmental management and development of the industry

## Zoning Legislation

The zoning legislation demonstrates the government's commitment and development priority. More importantly, it creates confidence among the investors because of the importance accorded to the industry.

### *Policies for sustainable shrimp culture*

## Aquaculture Research

Aquaculture research has been going on for a few decades now and has made significant contribution to the aquaculture industry. Most research focuses on the biological or farm operational aspects of individual species. Little information has been generated with respect to the planning and management of the industry. The aquaculture zone provides excellent opportunity and framework research in this direction.

## Shrimp Research

Shrimp research has not advanced fast enough when compared with those of other primary produce such as rubber and oil palm. Past aquaculture research tended to focus on those species that serve as food for the poor. In some international research agencies, shrimp research is not given any priority at all. The notion of aquaculture development for the poor still remains major guiding principle of some donor agencies. As such donor investment in shrimp research is relatively small compared with those of carps, tilapia or milkfish. Unfortunately, tilapia and milkfish are no more food within the reach of the poor. One should know that shrimp was once a poor man food in India.

The shrimp industry has generated more than $2 billion ( in not more ) in export trade and is comparable with that of the rubber industry in Malaysia. A rubber research institute was established for the industry so is palm oil research institute for the oil palm industry. It is about time to consider the establishment of a shrimp research institute if the potential of shrimp as a commercial commodity and as foreign exchange earner is to be fully realized.

## CONCLUSIONS

***Shrimp farming has undergone evolutionary changes in the last 5 decades: from small scale, traditional practices to large scale, technology oriented industrial farms.***

***There is no need to use mangrove swamps to grow shrimps.***

***There is a need to explore new way of doing things in order to have sustainable shrimp culture development . These will include:***

- application of integrated coastal management to ensure sustainable aquaculture/shrimp culture development
- perception and attitude change amongst all stakeholders
- a clear national policy for aquaculture including shrimp culture is essential
- areas for shrimp or other aquaculture should be allocated by law
- local government should play a greater role in environmental management
- ground water and coastal land used for shrimp culture should be adequately costed
- users pay and user say principle should be developed

# STATE AND SHRIMP
# A PRELIMINARY ANALYSIS OF THE ECONOMIC AND ECOLOGICAL CONSEQUENCES OF INDIA'S FISHERY POLICIES

by

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## 1. INTRODUCTION

The role of the state in initiating and sustaining economic growth and development has come in for close introspection. There is consensus about the need for an effective state. Without it, social and economic development would be impossible. The debate however, is around the issue whether this development should be state-provided or state-facilitated. Experience world-wide reveals a wide diversity of state action and its effectiveness. The role of the state as a provider, partner, catalyst, facilitator and regulator of economic growth and development have been observed. The state is normally regarded as consisting of three distinct sets of powers -- legislature, executive and judiciary -- each with its assigned role. The legislature makes laws; the executive implements them and the judiciary interprets and applies the law. All the actions of the various facets of the state are stated to be primarily intended for the good of society -- for its larger socio-economic and cultural development. Close examinations of the functioning of the state in one sector of an economy can provide us with deeper insights about its role and relevance in fostering development and change. We hope to make a preliminary analysis of this nature by examining the case of the role of the state in the fisheries sector of India, with special reference to the promotion of capturing and culturing of shrimp.

## 2. THE STATE IN INDIA'S ECONOMIC DEVELOPMENT

The state in India has played a variety of roles over time and across different sectors of the economy in fostering economic development. In the post-independence era, India adopted a planned economic development strategy which laid emphasis on both the role of the state sector and the private sector. This dual emphasis provided the basis for what came to be known as the "mixed economy" approach. Through the aegis of Five Year Plans ( there have been eight so far) the broad based direction for investment in each sector of the economy was decided.

### 2.1 In Industry

In the industrial sector the state held the "commanding heights" by owning and operating a range of industries including steel plants, aircraft assembling units, textile mills and bread making units, to name a few. The nature of entry and exit of private capital into industrial activity was highly regulated. There were industrial activities and production processes into which the state had monopoly access. Into some others, private capital had "limited access" and for the rest a licenced open entry.

### 2.2 In Agriculture

In agriculture the state has made large investments in irrigation projects, fertiliser plants and extended liberal credit to farmers through the network of government owned banks. Through a network of state funded research and educational institutions, the state has been instrumental in introducing new technologies, monitoring economic performance and providing the skilled human resources to foster development. The state also enacted legislation with regard to land holding and land utilisation to ensure greater equity and promote efficient utilisation of limited resources.

## 2.3 In Fisheries

Fisheries is a very small sector in the overall Indian economy. It has always been seen as an allied activity of the agriculture sector. Such a perception was probably appropriate for the inland and riverine fisheries but rather inadequate for the marine fishery.

The role of the state in fisheries in India predates independence. In the early 1900s the British initiated efforts to identify marine resources; experimented with new harvesting and processing technologies; promoted research and established a fishery bureaucracy ( Reeves et al, 1996). Several of the princely states, which did not come under direct British rule, also made pioneering efforts in promoting marine resource development with a variety of objectives. These included -- improving the livelihood of fishing communities; enhancing local fish consumption; and earning income for the state through domestic and foreign trade. The erstwhile princely states of Saurashtra in the north-west (now part of Gujarat State) and Travancore in the south-west (now part of Kerala State) provide the most outstanding examples.

Under the post-independence constitutional appropriation of control over economic activity, fisheries was "transferred" from the central (federal) government to the states in order that they make interventions appropriate to their respective socio-economic, cultural and techno-ecological contexts. Under this regime of division, the central government took on the role of providing the more capital intensive infrastructural investments such as fishing harbours. Numerous centrally sponsored schemes are commonly applied across states. However, the significant share of the financial commitments are made by the states in accordance with their needs and priorities. These laid stress on the fish harvest/production, processing and marketing activity. The social welfare of the fishing community also accounted for greater attention on the part of the states.

An examination of the investments made over the V-Year Plans reveals that the financial investments by the state governments have increased significantly over the plan periods from Rs. 41 million to Rs. 7630 million. The share of the central government has also increased over time in real and relative terms from Rs 10 million ( accounting for 15 percent in the First Five Year Plan) to Rs. 4000 million ( accounting for 34 percent in the Eighth Plan.) A significant share of this, as indicated earlier, has been spent on building infrastructure related to harvesting, processing and marketing and providing the institutional support for the same. The share of the fisheries sector has been increasing over time as a share of the allocation to the agriculture sector (See Table: 1)

**Table 1: Investment Outlays* in Fisheries by Central and State Governments during the Five Year Plans in Relation to the Overall and Agriculture Sector Outlay. ( In current prices Rs. millions)**

| Plan and Years | Overall Plan Outlay | Outlay for Agriculture & Allied Sectors | Of which for Fisheries | Outlay by the Central Government | Outlay by the State Governments |
|---|---|---|---|---|---|
| I Plan 1951-56 | 19600 | 2940 [15.0] | 51 (1.73) | 10 | 41 |
| II Plan 1956-61 | 46000 | 5290 [11.5] | 123 (2.32) | 37 | 86 |
| III Plan 1961-66 | 75000 | 10680 [14.2] | 283 (2.64) | 67 | 216 |
| Annual Plans | | | 422 | 153 | 269 |
| IV Plan 1969-74 | 159020 | 27280 [17.1] | 827 (3.03) | 340 | 487 |
| V Plan 1974-79 | 393220 | 43020 [10.9] | 1513 (3.51) | 680 | 833 |
| VI Plan 1980-85 | 975000 | 66090 [6.78] | 3712 (5.61) | 1738 | 1974 |
| VII Plan 1985-90 | 1800000 | 105740 [5.87] | 5465 (5.16) | 2173 | 3292 |
| VIII Plan 1992-97 | 4341000 | NA | 11630 ( NA ) | 4000 | 7630 |

[ ] share in total outlay ( ) share in agriculture outlay

* *The actual final expenditures are always short of the outlays. However they have improved from 54 percent in the Ist Plan to 94 percent in the VIII Plan signifying a greater demand for public investments in the sector.*

Source: GOI, 1994

In the context of our analysis, it is appropriate to consider the post-independence era of planned development of fisheries in three phases.

The first phase (1951-1966) includes the first three V-Year plans during which time fisheries was not a sector of very important priority in the economy. During these years the state's investments in fisheries were undoubtedly small compared to the large, and probably largely unaccounted, investments in the traditional sector of the fish economy which was considered to be a caste-bound occupation.

The second phase (1967-79) is marked by the new thrust for modernisation of the sector. The compulsion for the marked increases in the state investments in fisheries followed the country's first post-independence foreign exchange crisis of the mid-1960s when the Indian rupee was devalued by 57 percent. Given the deteriorating balance of trade position of that period, the significance and potential of shrimp exports as a major net foreign exchange earner was brought into focus (Wolf, 1982). The fisheries sector as a whole, particularly the marine sub-sector, acquired a new respectability. The vibrant, fast developing international market for shrimp in USA, Europe and Japan influenced the scale and direction of state financial outlays in fisheries across the maritime states of India. The major share of the financial commitments took the form of direct investments in shore based infrastructure such as harbours, landing centres, auction halls, ice making factories and freezing units. Liberal investment subsidies were also offered to individuals who invested in shrimp trawlers. States such as Kerala, Tamilnadu and Karnataka in the south, where marine shrimp ( penaeid variety) were available in commercially harvestable scales, took the lead in this matter. This state initiative was accompanied by vibrant private initiative from investors outside the traditional fish economy.[1] They seized the opportunity of the financial incentives offered by the state to make investments in trawlers, freezing plants and other related processing and marketing facilities. An important characteristic of this period was the concentration of these investments to a few key "growth centres" in each maritime state usually marked by the existence of one of the large harbours or fish landing centres constructed with state funds.

The third phase (1980-97) can be characterised as the period when new private investments in marine fisheries began to spread out along the whole coastline. These investments were being made by those who had been traditionally fishing. Imported outboard engines, new beach landing crafts and new designs of nylon nets were the hallmark of this phase. During the second half of this phase the initial spurt for so-called "deep-sea fishing" also got underway along the east coast. Large shrimp trawlers and tuna purse-seiners were imported by corporate investors with liberal support from financial institutions. Intensive coastal shrimp aquaculture also commenced from 1990s. Under the influence of global liberalisation, the state can be said to have been gradually withdrawing from its role as an active investor in the sector.

We can discern the initial rising and the subsequent falling of investment which we have described above by examining the manner in which the planned investments move in relation to the gross domestic product arising from the fisheries sector. (See Table 2)

**Table 2: Plan Outlay and Fisheries Sector GDP**
**(current prices. Rs. million)**

| Plan & Period | Plan Outlay (Rs. mill) | Fisheries Sector GDP during the period (Rs.mill) | Outlay/GDP (%) |
|---|---:|---:|---:|
| I-1951-56 | 51 | 2290 | 2.22 |
| II-1956-61 | 123 | 3400 | 3.62 |
| III-1961-66 | 283 | 5260 | 5.38 |
| Annual Plans 1966-69 | 422 | 5490 | 7.69 |
| IV-1969-74 | 827 | 13450 | 6.15 |
| V-1974-79 | 1513 | 29750 | 5.08 |
| VI-1980-85 | 3712 | 63110 | 5.88 |
| VII-1985-90 | 5465 | 137580 | 3.98 |
| VIII-1992-97 | 11630 | 531400* | 2.18 |

*FGDP for 1996 & 1997 are estimates

Source: CMIE, 1996 ; GOI, 1989: 12-14; GOI,1993

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[1] It is significant to note that until this period, the strong caste taboos in Indian society prevented investors from outside the dominant fishing castes making investments into fishing.

## 3. STATE AND MARINE SHRIMP CAPTURE

There was one common thread which we can discern through the important second and third phases: the focus on the export of fishery products, particularly shrimp.

It is not that the capture and export of shrimp from India was a post-1960 phenomenon. Shrimp was traditionally harvested and exported from India to the developing South and South-East Asian countries for well over a century. However, the shrimp was harvested only during certain seasons ( when they became pelagic) using selective nets or from traditional forms of tidal based shrimp-rice culture. All exports were in the dried form. The major changes in the post-1960 period pertain to the perennial harvest of shrimp using bottom trawlers, a switch to freezing technology for processing and a change in the direction of trade to the developed countries like USA, Europe and Japan.

The impact of this sea change in technology and markets is obvious from the rising quantum and value of these exports (See Table:3)

**Table 3: Average Harvest of Penaeid Shrimp from Marine Sources, Quantity and Value of Shrimp Exports and Total Marine Products Export Value for the Periods.**

| Year | 56-60 | 61-65 | 66-70 | 71-75 | 76-80 | 81-85 | 86-90 | 91-95 |
|---|---|---|---|---|---|---|---|---|
| Shrimp Harvest | 46 | 46 | 70 | 109 | 113 | 113 | 151 | 189 |
| Shrimp Export (Qty) 000 t | neg* | 4 | 15 | 34 | 49 | 53 | 55 | 84 |
| Shrimp Export (Val) Rs.mill | neg* | 26<br>(47) | 176<br>(51) | 612<br>(85) | 1864<br>(86) | 3003<br>(86) | 4620<br>(78) | 15110<br>(70) |
| Total Marine Exports (Val) Rs.mill | 49 | 55 | 248 | 716 | 2105 | 3504 | 5939 | 21684 |

* the frozen shrimp exports are negligible
Figures in ( ) are the share of value of shrimp exports to then total value of marine exports
Source: MPEDA, 1976, 1990, 1996

### 3.1 Costs of Foreign Exchange Earnings

The foreign exchange earnings rose rapidly due to the insatiable and growing demand for shrimp in the international market. This euphoria tended to mask the disparity between the benefit of foreign exchange earnings for the country and the financial, social and environment costs inflicted on society as a result of the anarchic development of the marine shrimp harvesting and export processing industry. Central to this was lack of any legislation -- except for the Indian Fisheries Act of 1897 of British vintage -- intended to regulate access into the sector, particularly into the realm of harvesting.

#### *3.1.1. Overcapitalisation*

The policy of open access to the coastal waters coupled with a lucrative subsidy scheme for the investment in trawlers led to a growing overinvestment in trawlers. As mentioned earlier, in the southern maritime states there was a conscious attempt to support investors who would fish for shrimp in the coastal waters with small trawlers. For example, in Kerala State, as much as 25 per cent of the cost of the hull of a trawler and 50 per cent of the cost of the engine were provided as grants. The remainder was treated as a loan to be repaid in 64 installments over a period of eight years at 7 per cent interest. ( Kurien & Achari,1990). Such largesse led to a proliferation of trawlers creating a situation of economic overfishing. In the state of Kerala which had the greatest number of trawlers and the largest shrimp harvest, loan repayment default became a serious problem. The owners of the trawlers were largely non-fishermen and persons who had good economic and political connections. Punitive action against them was therefore difficult. In 1986 a provisional estimate of the Government of Kerala assessed the accumulated arrears on government loan repayments due from the government funded trawlers at Rs 75 million. This was about 30 to 40 per cent of the investment cost. (Kurien & Achari,1990)

A government committee appointed to study the question of resource depletion and overfishing was of the unanimous opinion that the investment in Kerala's coastal waters was far above the desirable optimal levels. From these calculations it was estimated that the extent of overcapitalisation in the fishery was of the order of Rs 530 million -- an amount equal to the total planned fisheries development expenditure during the four Five Year Plans between 1951 and 1979 (Achari 1987). The situation in the other maritime states of southern India was not very different in respect to loan recoveries and overcapitalisation.

The situation was no different with respect to the active promotion of the so-called deep sea fishing vessels during the third phase. The number of vessels increased rapidly with the liberal financing from government owned financial institutions. (See Table 4)

**Table 4: Growth of Deep-Sea fleet**

| Year | Fleet | Power (HP) | Catch (tonne) | Annual Catch per trawler |
|---|---|---|---|---|
| 1970 | 6 | 2505 | NA | NA |
| 1978 | 56 | 24350 | NA | NA |
| 1981 | 59 | 25414 | 1649 | 27.9 |
| 1982 | 68 | 28700 | 1715 | 25.2 |
| 1983 | 68 | 28700 | 1638 | 24.0 |
| 1984 | 68 | 28700 | 2381 | 35.0 |
| 1985 | 75 | 31225 | 1419 | 18.9 |
| 1986 | 85 | 35000 | 1861 | 21.9 |
| 1987 | 100 | 42319 | 1050 | 10.5 |
| 1988 | 131 | 57398 | 1058 | 8.1 |
| 1989 | 157 | 69802 | 757* | 4.8 |
| 1990 | 168 | 74708 | 437* | 2.6 |
| 1991 | 180 | 81176 | 1565 | 8.7 |

* Fishing operations affected by crew strikes.
Source: Gudicelli, 1992

The consequence of this liberal financial support combined with open access to the resource was critically reviewed in the report of the Committee to Review the Deep Sea Fishing Policy. The report of this Committee which was submitted to the Ministry of Food Processing Industries in November 1995 states:

India has had no traditional entrepreneurship in the deep sea fishery sector which is highly capital intensive and risk prone. In order to promote investment in this sector for greater exploitation of marine fishery resources towards availability of fish for export earnings and for employment generation, the Government provided certain policy support for the development of the industry. The Shipping Development Fund Committee was entrusted with the task of extending soft loans to the deep sea fishing sector. Loans were provided to the extent of 95 percent of the cost of the vessel and the debt equity ratio was 6:1. A number of Indian companies acquired deep sea fishing vessels but almost all of these were shrimp trawlers and operated on the East Coast in a limited area from Visakhapatanam. The fleet strength of these shrimp trawlers continued to rise and their operations were economically viable till a point was reached when the gold rush tendency invited more players in the field than was sustainable on the basis of the available resources. The average catch per trawler reached an all time high of 35 tonnes per annum when the total number of vessels operating was 68 in 1984. As the number of shrimp trawlers continued to increase and reached 180 in 1991, the average catch per trawler hovered between 2.6 tonnes and 10.5 tonnes between 1987 and 1991. Approximately half of these shrimp trawlers are operating at present. The Government had offered a rehabilitation package to them in 1991, which was further liberalised in 1992, but these efforts have failed and another proposal for rehabilitation of the shrimp industry is under consideration of the Government. Earlier, the Government of India had abolished the Shipping Finance and Development Corporation (SFDC) and appointed Shipping Credit and Investment Corporation of India (SCICI) Ltd. as its designated agency to discharge the functions of the erstwhile SDFC including management of the loan portfolio, in 1987. (GOI, 1995)

### 3.1.2. *Ecological and Social Costs*

Overcapitalisation which was fuelled by the state took its toll of the marine ecosystem. Initially, during the mid-1970s and early 1980s, the imbalances were noticed in the coastal waters. Excessive trawling on a perennial basis greatly disturbed the demersal flora and fauna of the coastal waters resulting in significant changes in the quantum and the composition of the overall marine landings. This in turn affected the distribution of the output between the trawler fleet and the traditional crafts operated by the thousands of small-scale, coastal fishworkers who had continued by and large to use selective fishing gear. The physical conflicts between them and the trawlers which were in hasty pursuit of shrimp led to grave social tensions all along several coastal belts. In the southern states of Goa, Karnataka, Kerala and Tamilnadu, a major socio-ecological movement of the coastal fishing communities who were opposed to the indiscriminate trawling operations developed rapidly and coalesced into a national trade union. The various forms of collective action initiated by this organisation forced the central government to advice state governments to enact marine regulations which would zone the coastal waters into different TURFs (territorial use rights in fisheries) for the small-scale coastal fishworkers and the larger trawlers.[1]

It was against this background that the central government announced its new Deep Sea Fishing Policy of 1991 once again in the name of earning foreign exchange presumably utilising the untapped marines resources in the Indian waters. It accorded rights to foreign fishing fleets to access the Indian EEZ provided they entered into a joint venture agreement with an Indian entrepreneur. In the context of an already heavily overcapitalised fishery, which was described above, the potential adverse ecological and economic impact of this move was sensed by all the interests in the marine fish economy of the country. They buried their small differences, with regard to mutual problems in the coastal waters, and united to the bigger enemy. Once again, based on the widespread opposition and popular support for this agitation against joint ventures for so-called "deep-sea fishing", the central government was forced to rollback its "mare liberum" policies. (Kurien, 1995)

### 3.2 Assessing the Export Drive

Against the backdrop of these economic and ecological costs, the continued and unstinting financial support from the state for the coastal and the deep sea harvesting of shrimp and other marine resources as a source of foreign exchange earnings needs to be assessed. There are numerous ways by which such an assessment can be made. For example, if we could examine the trends in export earnings in constant US dollar terms we could assess the real commodity terms of trade. Alternatively, if we decompose the export earnings into different components we could assess if the gains are the result of supply determined or demand determined factors. Adopting this latter method, we observe that, based on a decomposition of the value of export earnings (See Annex C for methodology), despite the leading and facilitating investments by the state, and other forms of encouragement for product and market development, the enhanced foreign exchange earnings are largely due to price changes in the final product (demand determined) and not due to volume increases or greater product diversity (supply determined).

**Table 5: Decomposition of the Growth of Export Earnings**

| Period | Total Increase in Value during the period (Rs.Mill) | Percentage Increase due to change in total volume | Percentage Increase due to change in product-mix | Percentage Increase due to change in prices |
|---|---|---|---|---|
| 1967-80 | 1989 | 25 | 31 | 44 |
| 1981-94 | 32788 | 26 | 14 | 60 |

[Data for analysis taken from MPEDA, 1976,1996]

In the 13-year period from 1967-80 the export earnings increased by Rs.1989 million. During this period, which was after the first major devaluation of the Indian Rupee, the increase in the export earnings could be attributed to a balanced increase in the total volume of exports, the change in the product mix of exports and the changes in the price levels. The government's planned financial outlay for the fisheries sector as a whole during this period was Rs 2762 million.

In the second 14-year period from 1981-94, the export earnings increased by a phenomenal Rs 32788 million (over eight times the increase in the previous period). This was the period during which the economy as a whole was more liberalised and the thrust for exports much stronger. Despite this, we notice that the increase in earnings could be attributed more to the price changes mainly due to the floating value and devaluation of the Indian rupee ( official and unofficial) across this period. The governments planned financial outlay for the fisheries sector as a whole during this period was Rs 20807 million. The increased support by the government, greater access to new processing technologies and foreign markets as a consequence of the liberalisation, should have led to enhanced export earnings as a result of greater diversity of the export product-mix.

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[1] Detailed analysis of the ecological impacts of excessive trawling and the variety of responses of this by coastal fishworkers has been undertaken for Kerala State where the issue was most acute (Kurien, unrisd)

We notice from Table 3 above that during the period 1981/85 and 1986/90 the quantum of shrimp exports increased only from 53,000 to 55,000 tonnes. This stagnation came in for close scrutiny. It formed an important basis for the support, building up in India, for the promotion of coastal shrimp aquaculture.

## 4. STATE AND SHRIMP CULTURE

Just as marine shrimp harvesting was traditionally undertaken before the advent of state support for introduction of shrimp trawlers, so also coastal shrimp aquaculture has been undertaken in India from time immemorial. It was most often undertaken as a part of the larger agriculture cycle. It received little state support. In the coastal states of West Bengal, Orissa, Kerala, Karnataka and Goa, tidal-based systems of "no input, low throughput" produced between 15,000 to 20,000 tonnes per annum of shrimp. This harvest had been a steady source of supply to the export processing industry. These extensive aquaculture systems were also surrounded by a regime of overlapping rights for the fish farmer and the communities surrounding the farms.

The official reasons given for the active state support for promoting shrimp aquaculture in India can be found in a document of the Marine Products Export Development Authority (MPEDA), a government agency constituted by an act of parliament for the active promotion of marine exports:

".....the quantum of export of shrimps has been more or less around 50 to 55 thousand metric tonnes. ... This has led to the inevitable conclusion that despite several fold increases in fishing effort through mechanisation of fishing crafts, introduction of new fishing methods and gears, advanced fish finding devices etc. *shrimp harvest from nature remained more of less stagnant. Thus it is logically concluded the culture (sic) is the only alternative for augmenting export production of shrimp"* ( MPEDA, 1992:1 emphasis added)

An objective analysis of the data shows that what has been "logically concluded" is wholly untenable. The export of frozen shrimp from India between 1984/85 and 1990/91 can be said to have been stagnating (See Table 3 above). However, during the same (1985-1992) the harvest of penaeid shrimp (only penaeid shrimp are exported) from marine sources in India increased from 121,958 tonnes to 186,880 tonnes -- a 53 percent increase, registering a simple growth rate of 7.6 percent per annum (MPEDA, 1976,1990,1996)

The stagnation in the shrimp exports cannot therefore be attributed to the lack of marine harvests. The decline in export is more likely due to external market related factors and unrelated to the problems associate with marine shrimp harvesting in the country which, as indicated earlier, were many. Consequently the push for shrimp aquaculture must also have emanated from compulsions external to the performance or problems of the marine fisheries sector.

Many opponents of shrimp aquaculture in civil society have forwarded a variety of reasons to explain the surge and spread of coastal shrimp aquaculture with the abundant blessings of the state. We do not wish to enter that controversy here. It would suffice to say that their arguments gain credulence when the main "official" reason, as shown above, is found to be largely without basis.

The real reasons for the state sponsorship of coastal shrimp aquaculture can therefore be pinned down to all-economy factors. Most important among them was the stronger compulsions for earning quick foreign exchange in the post-1991 liberalisation era following the large borrowings made from the International Monetary Fund. Despite the fact that organisations like the MPEDA had made systematic efforts to promote scientific and sustainable coastal shrimp aquaculture from the mid-1980s, these efforts really began to hasten only after 1991 following the wider exposure of the Indian economy to the global markets. It is this opening up which provided the opportunity for international industrial interests, who were keen to find markets for the product and process technologies, to push corporate investors within India to take up shrimp aquaculture. In this pursuit they were often backed by the international financial institutions like the World Bank.

An example of the criteria used by these international industrial interests in assessing a country's suitability for technology transfer for shrimp aquaculture is shown below:

**Table 6:** Ranking of Asian Countries by International Investors with respect to their Perception of Status of Shrimp Aquaculture in Relation to Parameters to be Considered for Transfer of Technology

| Parameters | Taiwan (Province of China) | Indonesia | Thailand | Philippines | China | India |
|---|---|---|---|---|---|---|
| Industry motivation & competition | 1 | 1 | 2 | 3 | 2 | 3 |
| Technology Development | 2 | 3 | 2 | 3 | 1 | 2 |
| Mechanisms for transfer of technology | 2 | 3 | 2 | 3 | 1 | 4 |
| Capital Availability | 1 | 2 | 1 | 3 | 1 | 2 |
| Farmer's Experience | 1 | 2 | 1 | 2 | 1 | 3 |
| Industry Structure | 1 | 3 | 2 | 4 | 1 | 4 |
| Government Policy | 2 | 1 | 2 | 3 | 2 | 3 |
| OVERALL RANK (assuming equal weightage for criteria) | 2 | 4 | 3 | 5 | 1 | 5 |

(Source: Modified from data provided in Chiang, 1993)

The above Table 6 gives a cross-country ranking of private investors' perceptions of the status of the various criteria for making investments in the shrimp aquaculture industry across different countries in Asia. India is the least attractive if we assume that each of the criteria can be assigned equal weightage in the investment decision. Despite this, the spurt in the post-1991 investments in shrimp aquaculture are indicative of the overall welcome offered to investors by the state and the market.

With the exception of a handful, the majority of these new corporate investors had no earlier experience with the fishery or aquaculture business. They were attracted to shrimp aquaculture solely for the quick and large profits it promised.

The key technologies for the promotion of shrimp aquaculture are two: (1) the hatchery technology, geared towards reliable supply of quality fry in sufficient quantity and (2) feed technology essential for culture intensification. Both these were available in India, but certainly not in accordance with the quality standards or quantity available in the international market. The crash of the Taiwanese shrimp aquaculture in 1988 left its sharp impact on the internationally well known hatchery operators and feed manufacturers based there. They began to actively search for and promote shrimp farming in other countries in order to keep their business going. Leading feed manufacturers from Taiwan (Province of China) indicated that India was one of them. The initial ingress into the Indian market was through the aegis of a subsidiary company of Unilever in 1990. ( Chiang et al, 1993). The penetration thereafter was easier and quicker when several well known industrial houses in India entered the fray.

As per the Government of India, by 1993, as many as 61 corporate firms had registered as 100 percent Export Orient Units (EOU) for shrimp farming accounting for an area of 6027 hectares. Of this 31 projects were based in Andhra Pradesh and 27 of them reported having registered 3170 hectares of land for the activity (GOI, 1994: Table H:16).

### 4.1 State Incentives for Shrimp Culture

Apart from the facility of quick issual of licences for establishing shrimp aquaculture units, the state fostered the industry in a variety of other ways. Liberal lease arrangement of government lands on the coast, technical support, financial incentives, credit support and customs duty exemptions were the most important of these.

### *4.1.1 Lease Policy for Government Lands*

Most of the coastal states had special land leasing policies for shrimp farming enacted between 1986 and 1991. The exceptions were Goa and West Bengal. The allotment policies always gave priority to individual fishermen or to their cooperatives for leasing of government-owned land for very trivial sums of Rs 10 per hectare per year. Given the poor economic conditions of coastal fishermen around the country this was justifiable from the perspective of social justice. However, what is noteworthy is that the lease amounts stipulated for the other category of lessors -- small-scale entrepreneurs and big, progressive entrepreneurs was not very much larger. In Andhra Pradesh, the state leading in corporate shrimp aquaculture, the lease amount was Rs 20 per hectare per year for the small-scale entrepreneur subject to a maximum of 4 hectares and a mere Rs 50 per hectare per year subject to a maximum of 40 hectares per year for the progressive entrepreneurs which included the big business houses of the country. The maximum lease amount specified for these categories of lessors was in Karnataka state which specified an amount of Rs 2500 per hectare for the first five years and Rs 5000 for the next for the category of the small entrepreneur. For the big progressive entrepreneurs the corresponding amount was Rs 5000 and Rs 10,000.( MPEDA, 1992)

### *4.1.2 Technical Support*

The MPEDA provided a range of technical, extension and financial support for the active promotion of shrimp farming. The technology and extenuation support included "preparation of project reports for arranging credit facilities from financial institutions, besides technical assistance on farm construction, pond preparation, seed procurement, selective stocking, pond management etc." (MPEDA,1992:17)

### *4.1.3 Financial Incentives*

A complete and comprehensive assessment of the total amount of financial incentives and credit support given to the industry is yet to be undertaken. Several figures have been quoted. One estimate is that the bank finance involved is of the order of Rs 2000 million. Another estimate places the support for Andhra Pradesh alone at Rs.3000 million. (Raj & Dharmaraj, 1996:39)

The financial support in the form of subsidies and inexpensive bank credit were provided by MPEDA, the National Bank for Agriculture and Rural Development (NABARD), and the other nationalised banks in the country.

The MPEDA subsidies included:

a. Subsidy for new farm development; assistance of 25 percent of capital investment or Rs 30,000/ha up to a maximum of Rs 150,000.

b. Subsidy for establishment of shrimp hatchery: assistance on capital investment to a maximum of Rs 500,000 for hatcheries with a capacity of below 30 million seed/annum.

c. Subsidy on shrimp feed and seed: assistance of 25 percent up to a maximum of Rs 3000 per hectare for feed and Rs 450 per hectare per annum.

### *4.1.4 Credit Support*

The National Bank for Agriculture and Rural Development (NABARD) started financing the fisheries sector from its inception in 1982. It began to finance corporate shrimp aquaculture from 1989 onwards in a substantial way.

During 1991-94 NABARD extended financial support to "scientific and commercial shrimp farming to the tune of Rs 2400 million ( US Dollar 75 million in 1994)

**Table 7: NABARD Financial Support to Shrimp Aquaculture**

| Year | Total Financial Support(Rs. Mill) | Area Covered (Hectares) | Financial Support per hectare (Rs. Mill) |
|---|---|---|---|
| 1991-92 | 195 | 1986 | 0.10 |
| 1992-93 | 657 | 1885 | 0.35 |
| 1993-94 | 1553 | 2076 | 0.75 |
| Total | 2405 | 5947 | 0.40 |

Source: Calculated from (NABARD, 1994)

The support was spread rather unevenly across the coastal states as is evident in the Table: 8 given below. The bulk of the assistance has gone to the states where the new corporate shrimp aquaculture farms had taken root. The states where the traditional forms of shrimp aquaculture exist account for a mere 2 percent of the funds invested.

**Table: 8 State-wise Distribution of NABARD Funding**

| State | Water Area (Ha) | Outlay (Rs. Mill) | Outlay/ha (Rs.mill/ha) |
|---|---|---|---|
| Gujarat | 100 | 224 | 0.24 |
| Maharashtra | 118 | 122 | 1.00 |
| Karnataka | 67 | 12 | 0.18 |
| Kerala | 67 | 8 | 0.12 |
| Tamilnadu | 528 | 321 | 0.60 |
| Andhra Pradesh | 3578 | 1796 | 0,50 |
| Orissa | 1454 | 111 | 0.08 |
| West Bengal | 37 | 11 | 0.30 |
|  | 5949 | 2405 | 0.40 |

Source: Calculated from (NABARD,1994)

### *4.1.5 Customs Duty and Import Testing Exemptions*

The aquaculture industry was given the freedom to import shrimp feed and shrimp seed under the "Open General Licence" which implied that no prior or clearance of any kind was required. Although the feed did fall under the customs tariff nomenclature and did attract a duty of 35 percent, this was fully exempted by a notification issued in 1993. Data on the quantum of imports was only selectively available and is shown in Table 9. An aggregation of the value of imports ( Rs 187.46 million) in this incomplete Table reveals that the customs exemptions were worth Rs 65.6 million.

**Table 9: Quantity and Value of Shrimp Feed Imports**

| Year | Qty (MT) | Value (Rs.mill) | Price (Rs/mt) |
|---|---|---|---|
| 1988 | 121 | 2.73 | 22561 |
| 1989 | 932 | 20.89 | 22414 |
| 1990 | 1213 | 18.87 | 15556 |
| 1991 | 6243 | 113.57NA | 18191 |
| 1992 | 20000 | 31.40 |  |
| 1994/95* | 677 |  | 47076 |

*Data relates to import made by three firms through one port (Tuticorn) only.

Source: Kutty, 1995 and (*) Sekhar, 1997

The feeds and the seed were also exempted from any quarrantine or quality testing. The descriptions and other specifications provided on the import documents were accepted as valid for the customs assessment. In addition to this, aquaculture firms were also issued advanced licences for the vitamins and other chemicals used as additives for feed.

## 4.2 Spread of Aquaculture

Such unqualified support by the state resulted in a quick "pink gold" rush for a while. An examination of Table 10 below shows that the area under shrimp aquaculture doubled between 1990 and 1997. The production increased by well over two-fold between 1990 and 1994 but then fell sharply leaving the productivity level in 1997 below the 1990 level.

**Table: 10 Area, Production and Productivity of Shrimp Aquaculture in India**

| Year | Area (ha) | Production (tonnes) | Productivity (Kg/ha) |
|---|---|---|---|
| 1990-91 | 65100 | 35500 | 545 |
| 1991-92 | 68300 | 40000 | 585 |
| 1992-93 | 70700 | 47000 | 665 |
| 1993-94 | 82540 | 62000 | 750 |
| 1994-95 | 100700 | 82850 | 822 |
| 1995-96 | 119000 | 70570 | 593 |
| 1996-97 | 136000 | 70690 | 520 |

Source: MPEDA

The falling production and productivity were the reflection of a virus attack which affected all the states irrespective of whether they were largely into extensive or semi-intensive culture operations. Added to this came legal enactments ( see below) which created a climate of business uncertainty.

India was experiencing the historical "boom and bust" of shrimp aquaculture which has been documented in Ecuador, Taiwan (Province of China), China and Indonesia. The vital difference was that our productivity levels were a mere one-tenth that of the aforesaid nations when the decline occured.

## 4.3 Success for the Industry -- an Economic Bubble ?

Shrimp aquaculture can be undertaken at different levels of capital investment. This crucially depends on the intensity of the farming operation and the extent of backward and forward integration from the on-farm activities. In Andhra Pradesh for example, the vast number of small-scale operators, estimated by MPEDA to be as many as 50,000, exhibited an investment range from Rs. 12,000 to Rs. 38,000 per hectare. The returns (gross profits) on such investments ranged from Rs. 20,000 to Rs 125,000, yielding rates which even approached 200 percent. (Vivekanandan and Kurien, 1997). Compared to the alternative use of growing paddy on these farms, the absolute profit levels were quite phenomenal.[1]

The typical investment cost of an integrated aquaculture unit composed of a 200 million seed hatchery, a 600 tonne/annum feed mill, a 100 hectare farm and a 2000 tonne freezing plant was estimated to be about Rs 250 million ( 1993 prices). Conspicuous by its absence is that there is no mention of any effluent treatment plant as an integral part of the unit.

A sample of three corporate firms reveals that the profitability of their initial operations was largely adequate to recoup, in more than full measure, their own share of the capital invested.

*MAC Industries*

| Year | Sales (Rs.mill) | Net Profits (Rs.mill) |
|---|---|---|
| 1992 | 191.6 | 28.1 |
| 1993 | 295.5 | 35.2 |
| 1994 | 921.1 | 52.2 |

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[1] The investment for a hectare of paddy was Rs. 1000, the production cost Rs.1,400, the yield 800 kg and the gross profits between Rs. 1000 and 1,200 depending of the seasonal price.

With a face value of Rs 10 per share the book value of the shares of MAC Industries varied between Rs. 31.20 and 32.50 in 1993/94. The quotes on the stock market reached a high of Rs.93.

*Alsa Marine*

| Year | Sales (Rs. mill) | Net Profits (Rs. mill) |
|---|---|---|
| 1992 | 311.8 | 18.9 |
| 1993 | 478.8 | 23.4 |
| 1994 | 774.3 | 33.4 |

With a face value of Rs 10 per share the book value of the shares of Alsa Marine varied between Rs. 26.60 and 28.80 in 1993/94. The quotes on the stock market reached a high of Rs.65.

*Rank Aqua Estate*

| Year | Sales (Rs. mill) | Net Profits (Rs. mill) |
|---|---|---|
| 1992 | 28.5 | 0.4 |
| 1993 | 71.2 | 17.6 |
| 1994 | 314.7 | 55.2 |

Such a boom in profits and share prices brought happiness to the firm, the investors and the government. It was however very short-lived. The inability of the industry to exercise collective control over its effluent disposal created a situation of killing the goose which laid the golden egg. The combination of a natural disaster -- a cyclone -- and the spread of a virus like wildfire sealed the fate of most of the farms. After mid-1995 the share prices of the corporate firms began to fall and almost all aquaculture firms have been trading below par since then.

## 4.4 Ecological Crisis in Shrimp Aquaculture

From the economic boom to the ecological crisis of shrimp aquaculture took a rather short span of five years. During this period there was a sharp spurt in the number of investors who took to the activity. The minority of corporate sector firms, while making the greatest share of the profits, were outbeaten in number by the numerous small entrepreneurs and agriculturalists who rushed in to get a share of the bonanza.

### *4.4.1 Individual, small-scale aquaculturists.*

The vast majority of the latter just took on to shrimp aquaculture imitating, learing by seeing and doing and on mutual advice among themselves. They were largely without any formal assistance from the state in the form of either technical advice or financial support. Those who requested it were in all likelihood denied access to both, on the grounds that tenure to the lands they were to utilise was insecure. Such a situation was most prevalent in Andhra Pradesh, the leading state in shrimp aquaculture.

Studies undertaken among a large sample of such small-scale aquaculturists (Muralidharan & Udaya Shankar,1995) reveal that from the scientific point of view, there were numerous basic drawbacks in the site selection and layout as well as their water, feed and waste management practices. The investments were very low and consequently the rates of profit phenomenally high. They were often misguided by unscrupulous dealers of drugs and feeds. The cumulative impact of their uncoordinated waste disposal practices resulted in severe environmental stress. The outbreak of disease hit these aquaculturists the most, since it left many of them personally ruined, both financially and socially.

### *4.4.2 Corporate Firms*

The context of the corporate sector was of course entirely different. They had access to the best of everything from state, market and society. Armed with some well defined property rights to large tracts of land, they were in a position of strength to lease in more, procure more and encroach some if necessary. They also put to corporate use many open access lands like beaches, grazing lands ( often enclosing them) and mangroves, much to the disadvantage of communities dependent on these for a living. This process is described eloquently by a senior government official:

> Not so long ago much of the coastal area was an open access resource used primarily by local communities, now it is increasingly "privatized" legally or illegally. Aquaculturists are active, although not the only or the strongest players in this process." ( Dehadrai, in NABARD,1994)

The water management practices were probably good within the precincts of their own farms, the manner of the disposal of their effluents into public water bodies left much to be desired. These actions of theirs have come in for severe public criticism. In fact the basis of numerous public interest litigations against the shrimp industry stem from these actions. Environmentalists and social activists have also written militantly about these issues.

In our analysis we however resort to use of information from the leaders in the corporate industry to highlight their lack of self-discipline and cooperative action as regards effluent disposal. This will highlight how, when it comes to issues of larger eco-system concerns, "enlightened" private corporate interests are no different from the small-scale aquaculturists whom the former normally blame for making the crisis. However, unlike the latter, given the vast amount of societal subsidies and investment support which the corporate sector has received through state support, the corporate sector have little excuse for their lack of responsible behaviour.

### *4.4.3 The Case of Thapar Waterbase Ltd.*

Thapar Waterbase Ltd., the pioneer in integrated aquaculture provides the example of an outstanding victim of the industry-created crisis of self-pollution. Being a leader in the industry they had taken important initiatives to appeal to their fellow compatriots about the need for greater precaution in the farming practices. In their company newsletter[1] (Aug/Sep 94), an editorial titled "Are we going back to square one?" appeals to the industry not to go the way of the "collapse of the Taiwanese aqua castle." It points out that the corporate farms in Nellore District of Andhra Pradesh are not taking sufficient care of pond water environment management. It advocates caution saying:

> Water is the lifeline of this industry and abundant caution must be exercised in its proper use. In many places due to indiscriminate spurt in the number of ponds no proper drainage system exists. Outlets and inlets are close by. If this neglect continues we will have to pay the price. To avert this, the government should initiate some sort of well planned aqua industrial estates, but this will take some time. As an immediate alternative, wherever possible farmers should start cooperative effluent treatment facility where they should treat the discharge before releasing into the creek. They should check the water quality parameters and discharge the same after it has been found to be within the acceptable limits. (Waterbase Infoshare Vol 1/3 p.3)

The Newsletter of October 1994 sounds even more desperate with the editorial titled "Its better late than never." Here the editor states:

> In many parts of the country aqua farmers are facing problems in their culture. The problems may be different but the root cause for all these problems is lack of proper awareness or failure of healthy management practices. Even though it is late, the situation is still within our control..... The farmers should be very clear of the fact that they cannot trespass nature's limitations. The aqua industry should go hand in hand with environment. The current concern for the environment goes much deeper than just problem abatement in aquaculture. It is a belated recognition that as we "succeed" in terms of production, size, speed and growth, the quality of aquatic environment may deteriorate progressively. It is a belated recognition of our aqua industries oneness with nature. No doubt we are little bit late in recognising these facts. But its always better late than never. Because we have started late we must redouble our efforts to gain command of the situation. We must bring to bear the basic means of success -- good management practices with concern for environment ( Waterbase Infoshare Vol. 1/4 p.3)

However, within two years of these appeals the operations of the company came to a standstill. This is evident in the business newspaper report of March 1997 which states:

> The Thaper Waterbase Ltd. (TWL), a unit of the Thapar group which pioneered integrated aquaculture in Andhra Pradesh, suffered a severe setback in 1995-96 due to recurrence of the disease. During the year, the country's largest shrimp outfit had incurred a net loss of Rs 13.35 crores. The TWL's farm operations last fiscal( 1996-97) came to a standstill, its hatchery sales plummeted due to negligible demand, feed marketing operations were drastically affected and its processing facilities remained unutilised for major part of the year. The impact of the virus resulted in premature harvests and low output.

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[1]. The newsletter was started in May 1994. In the words of the Chairman of Waterbase Ltd. to "reiterate our corporate commitment to play an active role in the continued development of aquaculture in India, to be a corporate catalyst of the Blue Revolution"

With the brackishwater aquaculture running into rough weather, the focus now seems to be shifting towards freshwater aquaculture. Waterbase Ltd. is commencing trial production of freshwater shrimp seeds at it existing facilities.

(Business Line 17 March 97 "An epitaph for aquaculture")

## 4.5 State as Regulator: Role of the Judiciary

In the context of this ecological debacle which crashed the hopes of many, there was considerable debate on the role of the state. Should not the state act as a regulator of industrial activity which brings harm to itself and to others ? The facts reveal however, that the state was unable to bring defaulters to book despite the wide ranging legislative and organisational support it could have mustered for this purpose if the bureaucratic and political will was forthcoming. (*See Annex A for the list of legislative and organisational support available with the state*).

The inability of the executive and the legislature arms of the state to regulate the unsustainable aquaculture is admitted by a Deputy Director General of the Ministry of Agriculture:

> ..In the past decade much of the development, especially in coastal areas, was propelled by commercial interests that disregarded the limits of natural resources. Governments were unable to control excesses of the profit-oriented rush because suitable rules and regulations did not exist or the authorities did not have the means or the political clout to enforce them" (Dehadrai in NABARD,1994)

It is quite possible that each individual firm or small farmer was operating well within the threshold limits with regard to its internal environmental parameters. This may also have been verified and indeed certified by a pollution control authority. This fact alone was not a sufficient condition to ensure that the industry *as a whole* was within the limits of the assimilative and carrying capacity of the eco-system in which it was located. The onus of regulation of individual actions within the context of the larger physical environment is well within the purview of the executive and legislative arm of the state. It is when these fail to function that the judiciary come to the fore to enforce law on the basis of notice from private parties or the public at large.

It is in such a context that a public interest litigation filed by a social activist in 1994 was placed for hearing before the Supreme Court of India. The petitioner questioned the right of corporate entities to inflict both direct and indirect threats to life and livelihood of the coastal communities, by being unconcerned about the unidirectional externalities which we they impose in the course of their business activity.

An interim order by the Supreme Court, given in early 1996, put a stay on all further expansion of coastal shrimp aquaculture. This came as the last straw on the back of the industry which was reeling under the effects of self-pollution. The Supreme Court of India delivered its judgement on 11 December 1996 ordering the demolition of all aquaculture farms set up in the coastal regulation zone (CRZ), as defined under the CRZ Notification before March 31, 1997. The court also ordered the Central Government to constitute by January 15, 1997 an authority headed by a retired judge of a High Court with members having expertise in aquaculture, pollution control and environmental protection. This authority was to be given the powers to protect the ecologically fragile coastal areas, seashore, water front and other coastal areas and specially deal with the situation created by the shrimp culture industry. A batch of petitions from the shrimp industry associations seeking review of the court's order was rejected on February 4, 1997. Given this fate, on February 6, 1997 the Government issued a gazette notification constituting the Aquaculture Authority of India.

However, in March 1997 based on a fresh batch of review petitions from the Central Government, the MPEDA and four state governments, the Supreme Court gave an interim stay order on its own order of December 11, 1996.[1] The Supreme Court extended the deadline for closing all farms to April 30, 1997. The Central Government also placed before the Rajya Sahba (Upper House) an Aquaculture Authority Bill and got it hastily passed on March 20,1997. When this bill was placed before the Lok Sabha ( Lower House) the next day, it was kept in abeyance in anticipation of the Supreme Court's ruling due in April 1997. However, on April 25, 1997, at the third hearing of the review petitions, the stay for demolition was extended till July 31, 1997 and the next hearing of the review posted for July 25, 1997. ( At the time of writing in November 1997, the review petitions were still being heard and the demolition order stayed indefinitely )

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[1] One of the important influences which hastened the central and state governments to seek review of the court's order was the appeals from the financial institutions regarding the need to safeguard the huge credit outstanding in the hands of the corporate industry. See Annex B for a letter from the NABARD Chairman on this matter.

### 4.6 Social Cost-Benefit Analysis

At the instance of the Supreme Court the National Environmental Engineering and Research Institute,(NEERI) a government organisation, undertook a rapid assessment of the social cost-benefit of the shrimp aquaculture industry. The analysis was based on a quick survey in 1995 in the two states of Andhra Pradesh and Tamilnadu as well as the NEERI own data. According to the NEERI, the social and environmental cost of shrimp aquaculture are over 3.5 times the earnings from it. The annual earning from aquaculture in the two states is estimated at Rs.17780 million as against the total annual losses of Rs. 67280 million. The assessment of NEERI has been welcomed by the environmental activists and contested by the industry.

Our own assessment is that the assessment is partial both in respect of the costs and the benefits. As regards the benefits, the assessment is too narrow as it takes only the export earnings. For example, there has been considerable infrastructure developments and other spin-off industrial and service sector activity around shrimp aquaculture which has not been accounted for in the NEERI assessment. The benefits are therefore underestimated. On the costs side the assessment has considered some important economic costs but has only considered the negative ecological externalities which accrue in some parts of the ecosystem spectrum involved in the process of coastal shrimp aquaculture ( For a schematic presentation of the ecosystem spectrum involved in intensive shrimp aquaculture see Kurien, 1997). The ecological costs are therefore an underestimate.

On balance however, it would be right to infer that the general conclusion of NEERI that the social costs are larger than the social benefits is valid. The degree to which this is so needs to be more carefully assessed.

## 5. STATE AND SHRIMP: TOWARDS A NEW RELATIONSHIP

This preliminary analysis which we have made of the economic and ecological consequences of India's fishery policies, with particular reference to the promotion of the capture and culture of shrimp, has highlighted some salient features about the relationship between the state and the fish economy.

Initially, we see how the initiative of the state, to lead the direction of investments towards the capture and export of shrimp succeeded to motivate private investment and enhance the export earnings. Given the open access nature of the state owned coastal waters, the scramble for the profits to be made resulted in gross overcapitalisation. The economic implications of this, for a developing economy where capital is scare, are serious. It deprives other sectors of the economy of funds which may have been more socially and productively used therein. The ecological and social consequences were also widespread. They however, appeared with a lag for the simple reason that it took time for collective awareness to develop about the ill-effects. However, when the awakening did arrive, the socio-ecological protest was sharp and widespread, much to the chagrin of the state.

From the renewed state policies of the late 1980s and early 1990's, in particular, the thrust into the so-called deep sea shrimp operations and the hasty foray into coastal shrimp aquaculture, it would seem that the experience of the 1970s and 1980s did not lead to an institutional learning on the part of the state. The primary lesson on the need to regulate the inputs and outputs into an open access resource in order to avoid its ruin has not been learnt. The faith that the summation of reasonable individual actions will necessarily lead to the larger social good is called to question.

If the state is to be perceived by civil society to be the ultimate custodian of our natural resources which must be utilised for present and future generations, it should be able to enforce the adoption of a far more precautionary approach in activities of harvesting, conservation and management when utilising natural resources for achieving short-term economic gains.

To achieve this, the three arms of the state must perform their distinct roles but function in unison. In the context of the fishery sector, the recently formulated FAO Code of Conduct for Responsible Fisheries provides a framework within which a clear articulation of coordinated state action can be envisaged for a sustainable development process which will maximise overall social good within the limits of the natural productive capacity of the resource.

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## Annex A

### Legal Framework and Organisational Set-up Relevant for Promoting and Regulating Shrimp Aquaculture Development

(Adapted from Alagarswami,1995)

LEGAL FRAMEWORK

*Central Government*

1. The Indian Fisheries Act of 1897 ( Government of British India)
2. The wildlife (Protection) Act 1972
3. The Water (Prevention and Control of Pollution) Act 1974 and amendments
4. The Water (Prevention and Control of Pollution) Cess Act 1977 and rules
5. The Air (Prevention and Control of Pollution) Act 1981 and amendments
6. The Environment (Protection) Act 1986 and its three amendments in 1987
7. The Coastal Regulation Zone notification of 1991 (issued under 6. above)

*State Government*

1. Land Utilisation Acts
2. Fishery Regulation Acts ( issued under Indian Fisheries Act 1897)
3. Shore or Coastal Area Development Acts
4. State Pollution Control Boards

ORGANISATIONAL SET-UP

*Central Government*

Union Ministry of Agriculture, Department of Agriculture and Cooperation, Fisheries Division
Union Ministry of Commerce
Union Ministry of Environment, Forests and Wildlife
Indian Council of Agriculture Research, Fisheries Division
Council of Scientific and Industrial Research
National Remote Sensing Agency
Department of Biotechnology
Department of Ocean Development

*Indian Council for Agriculture Research (ICAR) Fisheries Institutes*

Central Institute of Fisheries Education
Central Institute of Brackishwater Aquaculture
Central Marine Fisheries Research Institute
National Bureau of Fish Genetic Resources
Central Institute of Fisheries Technology

*Council for Scientific and Industrial Research (CSIR) Institutions*

1. National Institute of Oceanography
2. National Environmental Engineering Research Institute

*Ministry of Agriculture Institute*

1. Central Institute of Coastal Engineering for Fishery

*Ministry of Commerce Authority*

1. Marine Products Export Development Agency

*State Governments*

1. Departments of Fisheries
2. Fish Farmer Development Agencies (District level)
3. Brackish Water Fish Farmers Development Agency (District level)
4. State Fish Seed Corporations
5. State Pollution Control Boards
6. Fisheries Colleges and other University Departments (eg. Aquatic Biology)

## Annex B

### Abstracts from the letter of the Chairman of NABARD to the Chief Minister of Orissa appealing that the government should get the court to review its decision to demolish the aquaculture farms violating the CRZ Regulation.

"As you are aware, after the liberalisation process was initiated, aquaculture industry has been getting a tremendous boost. Many of the corporate entrepreneurs have gone in for shrimp farm activities in the coastal areas of Tamilnadu, Andhra Pradesh, Orissa, Maharashtra, Gujarat and Goa. Many schemes have been sanctioned by the banking system with or without refinance assistance from NADARD. In addition, term lending institutions such as IDBI, ICICI, SCICI etc have also financed these farms in some of the states. Under NABARD refinanced scheme, the total financial outlay under aquaculture projects aggregated about Rs 425 crores with bank loan components of Rs 260 crores.

The (Supreme Court) judgement has serious implications for the aquaculture industry. This will halt the development process and the exports. In the case of the farms which are affected by this order, the entire asset will be reduced to zero and the entrepreneurs will also have to bear the additional burden of paying compensation to the workmen. The banking and financial system will have serious problems in recovering the dues.

In view of the serious implications, NABARD had discussed this issue in a meeting of bankers on January 2, 1997. The bankers were unanimous that NABARD may request Government of India and the concerned state governments to initiate action for filing a review petition and also take follow-up action to mitigate the problem.

.....It is necessary to protect the development that has already taken place and also draw up a long term plan of action for orderly and sustainable growth of the industry in future....... The (state government) may therefore consider moving the Government of India so that the notification could be amended retrospectively so as to protect the units which have already been set up and save capital losses.

( The Hindu, June 15, 1997 " Aquafarming: the money factor")

# Annex C

## Methodology for the Decomposition Model

### Data Requirements

The quantum and price (or value of output) of the different products in the marine export basket for the two (or more) points of time where are to be compared.

### Method

1. Base period = b   The Current period = c
2. Average output of product in these periods = Obi and Oci
3. Average price of products in these periods = Pbi and Pci
4. Number of products = n
5. Total output of b and c =   Obi = TOb, similarly TOc
6. Average value of output of b and c =   Obi.Pbi = Vb, also Vc
7. Average unit value of output of b =   Vb/TOb = UVb
8. Value of output of c in b prices =   Oci.Pbi = Vcb

### Calculations

a. Total increase in value of output between b and c:

Vc - Vb ..............(1)

b. Increase in value due to change in product-mix between b and c:

Vcb - Vb .............(2)

c. Increase in value due to change in total output between b and c:

[TOc - TOb]. UVb .....(3)

d. Increase due to price changes alone:

(1) - [ (2) + (3) ]

# SALIENT LEGAL AND INSTITUTIONAL FEATURES WITH REGARD TO THE DEVELOPMENT OF SHRIMP CULTURE IN A FEW COUNTRIES

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## Malaysia

Aquaculture is regulated under the Federal Fisheries Act, No. 317 of 1985 as amended ("the Act") and two regulations made under it: the Fisheries (Marine Culture System) regulations, 1990 and the Fisheries (Cockle Culture) regulations 1964, as amended in 1982.
In addition to the Fisheries Act and its regulations and the various State rules on inland or riverine fishing, the following laws and regulations are relevant to the regulation of aquaculture:

- the National Land Code, 56 of 1965;
- the Environmental Quality Act, 127 of 1974;
- the Food Act, 281 of 1983; and
- the Promotion of Investments Act, 327 of 1986.

As a consequence of the constitutional division of legislative competence between the Federal and State governments, the regulation of aquaculture is based on a distinction between aquaculture conducted in "maritime waters" (which is primarily the responsibility of the Federal government) and aquaculture conducted in "riverine waters" (which is primarily the responsibility of the State government). Shrimp culture falls within the aquaculture activities conducted in "riverine" waters.

There is currently no legislation regulating the establishment and operation of shrimpculture facilities other than the usual requirements for obtaining access to (state) land and to conduct an EIA if the project involves the destruction of more than 50 hectares of mangroves.

### *Environmental Impact Assessment Requirements*

Land-based aquaculture projects accompanied by clearing of mangrove swamp forests covering an area of 50 hectares or more are defined under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order, 1987 as "prescribed activities" for the purposes of section 34A of the Environmental Quality Act, 1974. As such they are subject to the environmental impact assessment procedure established by the Department of Environment (DOE). It is also possible that very large aquaculture developments would also require an EIA by virtue of some other impact, for example if it involved changing the type of agricultural use of an area of 500 hectares or more or the drainage of a wetland or wildlife habitat of more than 100 hectares or more, or the clearing of mangrove swamps on islands adjacent to national marine parks.

The State of Sarawak has its own Natural Resources and Environment (Prescribed Activities) Order 1994[1] which provides that the following activities listed in Schedule 1 are "prescribed activities" requiring an EIA:

(a) conversion of mangrove swamps into agricultural estates having an area exceeding 50 hectares (item 1(ii));

(b) creation of lakes, ponds or reservoirs for the rearing of fish or prawns, exceeding 50 hectares in area (item 4(ii)); and

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[1] Notice No. Swak. L.N. 45 of 18 August 1994, Sarawak Government Gazette Part II vol. XLIX no. 20.

(c) fish culture and other forms of fishing on commercial scale which involve the setting up of fishing appliances and equipment in the rivers or watercourses (item 5);

The Sarawak Ordinance also provides that where the Schedules specify a minimum area for conducting a prescribed activity this applies regardless of whether the activities are carried out at one time or in phases (Rule 2(2)).

*Control of effluents and water quality*

The Environmental Quality Act ("EQA") is primarily concerned with the prevention, abatement and control of pollution from industrial sources. Acceptable conditions of discharge for *effluent* (defined as sewage and industrial effluent) into inland waters have been established (under the. Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979). However the Department of the Environment (DoE) takes the view that since effluent from aquaculture facilities is not "industrial effluent"[1] it is not subject to the provisions of the Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979. Consequently, the DoE does not apply any standards to effluent from aquaculture and does not require aquaculturists to obtain licences to discharge effluent under the EQA.

There are currently no legal requirements which specifically require an aquaculturist to monitor, sample or control the quality of the waters used although the law does require measures to be taken to avoid disease outbreaks and to produce fish fit for human consumption.

*Other issues*

The Food Regulations contain several provisions relevant to aquaculture products. Part VII of the Regulations deals with "incidental constituents" which is defined as meaning foreign, extraneous, toxic, noxious or harmful substances on or in food including metal contaminants, micro-organisms and their toxins, antibiotic residue and pesticide residue.

The Regulations prohibit the import, preparation, advertisement for sale or sale of food intended for human consumption, including fish and fish products, which:

(a) contain more than the specified maximum permitted proportions of metal contaminants;[2]

(b) are contaminated with pathogenic micro-organisms or which contain more than specified maximum mycological contaminants;[3]

(c) contain detectable antibiotic[4] residues or their degradation products (regulation 40(2)) but chlortetracycline or oxytetracycline may be incorporated in ice used for preserving fresh fish and unpeeled shrimps provided that the concentration of one of these antibiotics does not exceed five parts per million in the product (regulation 40(3)); and/or

(d) contain more that the prescribed maximum residue limits for pesticides in food (none of the current limits are applicable to fish and fish products) (regulation 41, Schedule 16).

The Regulations also specifically provide that "fish[5] that are cultivated or bred for human consumption shall have been procured from a clean location" (regulation 156(2). and prescribe standards, modes of preparation and particular labelling requirements for specific types of fish and fish products (regulations 156 to 170).

*The Administration of Aquaculture*

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[1] Section 2 of the Regulations defines "industrial effluent" as "liquid water or wastewater produced by reason of the production processes taking place at industrial premises".

[2] Regulation 38 as read with the fourteenth schedule.

[3] Regulation 39 as read with the fifteenth schedule. The microbiological standards for fish and fish products ready for consumption (excluding those in hermetically sealed containers) are as follows : Total Plate Count at 37°C for 48 hrs:. $10^6$ per g; Coliform Count at 37°C for 48 hr: 5 x10 per g; the *Escherichia coli* count should comply with good manufacturing practice; and the maximum permitted proportion of aflatoxin or any other mycotoxin" is. 35 microgram per kilogram.

[4] The word 'antibiotic' means "any chemical substance, produced either by chemical synthesis or by a micro-organism, which has the capability to inhibit the growth of, or to destroy, bacteria and other micro-organisms" Regulation 40(1).

[5] "Fish" is defined as including any marine, brackish water or fresh water fish, crustacean, mollusc and other aquatic life that is edible by human being, including fish roe. (The Food Regulations, 1985, reg.156 (1))

The Department of Fisheries within the Ministry of Agriculture is responsible for the administration and implementation of the Fisheries Act and consequently for regulating aquaculture to the extent that it falls within the jurisdiction of the Federal Government. Hence the administration and regulation of shrimpculture falls within the jurisdiction of the States.

### *The Kedah Shrimp Farming Development Committee*

In Kedah there is a special procedure for establishing a farm to culture shrimps in ponds. In 1993 an ad hoc Shrimp Farming Development Committee ("Sfdec") was established to prepare regulations on inland aquaculture and to screen applications for land to be allocated for the purposes of shrimp farming. The Committee is co-ordinated by the Kedah State Economic Planning Unit ("Sepu") and chaired by the State Exco member responsible for Agriculture (the equivalent of the Minister of Agriculture at the State level). Sfdec is made up of representatives of the State Land Office, the federal Town and Country Planning Department, DoE, DID, State Department of Agriculture, Department of Fisheries, the Fisheries Development Agency (LKIM ), and the Department of Forestry. In addition Sfdec calls on the services of a group of experts at the University of Science Malaysia (USM) when required.

Applicants must complete a standard application form (form 4A) and submit it to the Sepu which will arrange a series of meetings of Sfdec until a decision is reached. This will be forwarded as a recommendation to the State Exco which actually makes the decision. Members of Sfdec regard it as having been successful and as particularly useful in facilitating integrated consideration of applications. However, the view was expressed that it would be helpful for the Committee to have greater access to technical expertise.

## **Ecuador**

Aquaculture is regulated under the basic fisheries law i.e. Ley de Pesca y Desarrollo, No. 178 de 19/02/1974, as amended by the DL 03.RO 252: 19-VIII-85 and the regulations made under it: Reglamento para Cría y Cultivo de Especies Bioacuáticas No. 12771 de 05/09/1975; Acuerdo No 14425 de 19/07/1978; Acuerdo de la Subsecretería de Recursos Pesqueros de 22 Abril de 1985; Reglamento para Cría y Cultivo de Especies Bioacuáticas de 02/09/1985.

In addition to the fisheries law, the following laws and regulations are relevant to the aquaculturist:
Decreto de Protección del Manglar de 27/03/1995; Reglamento para la Ordenación, Conservación, Manejo y Aprovechamiento del Manglar de 19/12/1995; Water Act, 1972, Sec. 34 and Water Act Regulation, 1973, Reg.85; Ley de Desarrollo Agrario de 14/06/1994, cap.1; Codificación de la Ley de Desarollo Agrario, Cap.VII.

The basic fisheries law requires any person willing to engage in aquaculture to obtain an authorisation from the Ministry of Natural resources (art.2, art.18). It provides for a general prohibition to destroy or alter mangroves and to establish aquaculture activities within protected areas ("reserva natural") (art.47)

Apparently to respond to a precise need, Ecuador enacted in 1975, an Ad Hoc Regulation on the breeding and culture of aquatic species. The regulation provides for a legal framework for coastal aquaculture and more specifically for the access and use of "zonas de playas y bahías" by means of land leases (concesión de ocupación) for aquaculture purposes for these areas belong to the public domain. The procedure aims at obtaining, during the "inspection" phase, a favourable report of all persons and state organizations concerned and to involve Ministries in the allocation of the authorisations.

As such shrimpculture activities undertaken in the coastal areas ("zonas de playas y bahías") are to be authorised by the Directorate of Fisheries (aquaculture licence), as well as by the Ministries of National Defence and of Natural Energy Resources. (art.52 of the fisheries law and art.11 of the Regulation 12771) following an inspection of the requested area by the Directorate General of Fisheries, the National Fisheries Institute and INEFAN (*Instituto Ecuatoriano Forestal de Areas Naturales y Vida Silvestre)*. An "Interministerial Agreement" ("Acuerdo de concessión") between the state bodies referred to is drafted and once promulgated, the licence holder(s) will receive the "matricula de ocupación" to be renewed annually and upon payment of fees. The concession is granted for 10 years and can be renewed upon request under same terms and conditions. The concession will remain without effect if the licence holder does not pay the annually established registration fee. An inspection will take place each year prior to the payment of the registration fee. The concession cannot be transferred nor sold. Applicants are required to submit geographical, technical and administrative documents and information. Limits are set on the areas granted: minimum 10 ha and maximum 50 ha for individuals and minimum 50 ha and maximum 250 ha for companies. No limits are set where the land is privately owned.

### *Mangrove issues*

Since 1995, mangroves have received special attention through the enactment of two specific legislative texts: il Decreto de Protection del Manglar de 27/03/1995 and il Reglamento para la Ordenacion, Conservacion, Manejo y Aprovechamiento del Manglar de 19/12/1995. They set a general prohibition to establish new shrimpculture activities and to extend existing ones in mangrove areas; INEFAN, the institution which is in charge of the conservation of mangroves has been vested with special inspection powers with regard to shrimpculture farms within or closed to mangrove areas.

### *Water use and water quality*

The Water Resource Institute of Ecuador is empowered to grant water use rights in respect of sections of rivers and other natural or artificial watersheds for the culture, harvesting and exploitation of "aquatic flora and fauna"(Water Act, 1972, Sec. 34 and Water Act Regulation, 1973, Reg.85; Ley de Desarrollo Agrario de 14/06/1994, cap.1; Codificación de la Ley de Desarollo Agrario, Cap.VII).The authorisation to use water incorporates the authorisation to discharge water. According to the Ecuadorian Water Regulations, studies and works concerning water catchment, conduits, diversion, storage and discharge of water may only be executed upon approval of the Water Resource Institute of Ecuador and having regard to the legal requisites relating thereto. (Supreme Decree No. 40 issuing The Water Act Regualtions, 1973, art.187). The Water Authorities supervise, jointly with the Ministry of Health, all installations for the treatment of water that has become polluted (The Water Act Regulations 1973, art.92). On the other hand, pursuant to the Health Code, the following prohibitions exist:

1. nightsoil, waste water and industrial water may not be discharged, directly or indirectly, into streams, rivers, lakes, conduits or any watercourse used for domestic, a agricultural, industrial or recreational purposes, unless they have first been subjected to treatment to render them harmless to health (The Health Code No.188, 1971,arts.12&17);
2. the discharge into sewerage systems, streams, conduits, rivers, lakes or sea, or the seepage into the soils of effluents containing contaminants that are harmful to human health, the fauna, the flora or to property when such effluents do not conform with the technical rules and regualtions prescribed by the authorities (Ibid.)

In addition the fisheries law (Decree No178 of 1974) prohibits to direct the used waters, without proper treatment, towards shores/beaches and seabanks, rivers, lakes, natural and artificial basin as to cause any form of pollution (Ley de Pesca y Desarrollo, art.47, d).

Last but not least, shrimp farming industries, in order to obtain tax exemptions or special incentives in accordance with the category of enterprise they belong to must, inter alia, possess a system of treatment for the water they used, approved by the Director General for Fisheries and other competent authorities to avoid environmental pollution (Acuerdo ministerial No 13319 of 1976, Arts. 3(i) and 3(j)).

### *Administration of shrimp culture*

Institutional wise, as seen above, the Ecuadorian authorisation procedure involves the Ministries of Natural Resources and National Defence, the Department of Merchant Marine and Coasts and INEFAN. On the one hand, they determine, according to the fisheries law, the maritime areas, shores, tidelands, rivers and lakes and swamps available for public use where the establishment of fish ponds or cisterns for the conservation and fattening/feeding of bioaquatic species and laboratories, agrarian and experimentation centres, may be undertaken;[1] on the other hand, they decide whether or not to grant the authorisation and together they prepare the "Interministerial Agreement on Concession", should the requested authorisation be granted. A special Commission has been set up for this purpose.

There are currently no legal provisions which explicitly require the shrimp farmer to monitor, sample or control the quality of the waters used. These provisions may however be laid down in the Agreement. Unidades de Control y Vigilancia have been created assisting the Government in its regulatory and enforcement tasks.

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[1] Article 52

## Honduras

Honduras does not appear to have special measures with regard to aquaculture, leave aside shrimpculture. In 1993, the Government of Honduras enacted an general environmental law which indirectly addresses environmental concerns of aquaculturists, including shrimp farmers (Decree No 104-93).

Procedures that seek to prevent environmental deterioration of coastal areas (Decree No 104-93, Title III, Chap.1) and which affect shrimp farmers include:

- the designation of spawning areas and nursery grounds as areas which deserve "special protection and control";
- the general prohibition to discharge "all kinds of polluting wastes, whether solid, liquid or gaseous, liable to affect people's health or aquatic life, harm the water quality to its own detriment, or alter the ecological balance in general";
- the zoning of specific coastal and maritime areas;
- the obligation to treat organic and solid waste from industrial, agricultural, livestock activities in order to prevent alterations of rivers, lakes, ponds, and maritime waters;
- the obligation to undertake an EIA for "shrimp or prawn" activities;
- obligation of the "shrimp or prawn" farmers to obtain an authorisation from the competent authority;
- the provision of tax abatements and exemptions for "any investment in filters or in any other technical equipment used for preventing and cleaning pollutants, produced by industrial, agricultural, livestock, forestry or other companies carrying out potentially polluting or degrading activities. "

This text introduces the concept of environmental offences likely to lead to definitive closure and/or temporary suspensions of activities and/or confiscation of tools and instruments used in the commission of the offence and/or cancellation of economic benefits, for anyone, who, violating the laws, regulations and technical rules protecting the environment.

Guarantees of information and participation of the public have been incorporated in this national law. Likewise legal measures recognise a particular role for national and international non-governmental associations in the implementation of the environmental law and education of citizens in environmental matters.

Competent State Departments, together with the Municipalities shall carry out surveillance and control in their respective areas of jurisdiction.

## Sri Lanka

Any person willing to engage in coastal shrimpculture is likely to be subject to the following consent processes (prior to the commencement of any construction or land development). Depending on the size of the envisaged development, the granting procedures may differ i.e. be more complex. In accordance with the classification of aquaculture enterprises: a distinction is made between brackish water pond culture of shrimp smaller or larger than 1 ha and shrimp hatcheries with annual production of respectively 5, 10 and above 10 million.

### *Access to shrimp culture*

The consent processes are:

- the aquaculture licence under the Fisheries and Aquatic Resources Act, No. 2 of 1960; the application for a licence will include the license fee, copies of permits/approvals obtained under any other law; and such information as the Director may require. (The Aquaculture Management Regulations of 1996, regs.3&4)[1]
- the IEE/EIA[2] process requirement developed under Part IV C of the National Environment Act Nos 47 of 1980 and 56 of 1988 (hereinafter "NEA") and the Draft National Environmental (Procedure for approval of projects) Regulations, No 1 of 1993 (hereinafter "DNER, 1993");
- the Environmental Protection Licence under Part IV A of the NEA and National Environmental (Protection & Quality) Regulations, No.1 of 1990 (hereinafter "NER, 1990");
- the approval by local authorities, relevant agencies and institutions that have vested interest in the particular area, for instance an authorisation to occupy said area;

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[1] hereinafter called AMR/96

[2] IEE refers to Initial Environmental Examination; EIA refers to Environmental Impact Assessment.

- a coast conservation permit ("CC permit"), if the envisaged shrimpculture development lies within the "Coastal Zone"[1] ("CZ") as defined in the Coast Conservation Act, Nos 57 of 1981 and 64 of 1988 (hereinafter "CCA" ) because aquaculture is considered as a development activity[2]. As such aquaculture undertaken within the CZ is a development activity for which a CC permit is required.[3]

The aquaculture licence is not transferable, valid for a period of 12 months, subject to such conditions as the licensing authority may specify and renewable. The Director may limit the number of aquaculture licences for reasons of national economy and environment (AMR/96, regs. 8-9). During the granting procedure the Director may set up a Technical Committee to deliberate on the application (Ibid., regs.10-11). The aquaculture licence may be cancelled should the operation of aquaculture enterprise causes any threat to the environment (Fisheries and Aquatic Resources Act, No.2 of 1996).

With regard to the CC permit, the Director of the Coast Conservation Department ("CCD") issues such a permit if the activity is consistent with the management policies set in the Coastal Zone Management Plan and will not affect the stability, productivity and environmental quality of the CZ.[4] He may also require an EIA to be prepared by the applicant before taking any decision.[5]

Access to aquaculture could be restricted in the future by the upcoming National Wetlands Heritage Act, No.. of 199.. The objectives of this act are to protect, to preserve and to conserve the natural wetlands heritage and to provide for the formulation of a National Wetlands Policy including the regulation of activities in wetlands.

*Environmental Impact Assessment*

The EIA process applies only to "prescribed projects".[6] ("pp") They have to be approved by the "appropriate Project Approving Agency" (PAA)[7] before they can be implemented.[8] As such, the MFAR is a PAA[9] for PP in fisheries matters but should the MFAR be a project proponent (i.e. the developer of the project), then it will be disqualified from acting as the PAA for that project.[1] A key question here is whether aquaculture a PP? The approach, adopted by the Minister of Environment has been to establish three lists describing the projects that would require an EIA/IEE before they can be implemented.[2] Following are the aquaculture projects which can be considered as PP and thus are coming within the IEE/EIA process requirement: (i) Coastal aquaculture development projects extending over> 4 ha and wholly or partly outside the CZ.[3]; (ii) any project or undertaking located wholly or partly outside the CZ involving a conversion of forests covering an area exceeding 1 hectare into non-forest uses is a prescribed project[4]; and (iii) any aquaculture project and undertaking irrespective of their size and irrespective whether they are located in the CZ or not, and if located wholly or partly within "environmentally sensitive areas".[5] This definition should concern any aquaculture project located within 100 m from the boundaries of mangrove areas.[6]

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[1] Coastal zone means "that area lying within a limit of three hundred metres landwards of the Mean High Water line and a limit of two kilometres seawards of the Mean Low Water line and in the case of rivers, streams lagoons, or any other body of water connected to the sea either permanently or periodically, the landward boundary shall extend to a limit of two kilometres measured perpendicular to the straight base line drawn between the natural entrance points thereof and shall include the waters of such rivers, streams and lagoons or any other body of water so connected to the sea;"(CCA, section 42)

[2] Two permits provided for under the CCA are particularly relevant for the aquaculturists:(i) a permit to develop an activity within the CZ: "Notwithstanding the provisions of any other law, no person shall engage in any development activity other than a prescribed development activity within the Coastal Zone except under authority of a permit issued in that behalf by the Director".(section 14 of the CCA). A development activity means any activity likely to alter the physical nature of the CZ in any way, and includes the construction of buildings and works, the deposit of wastes or other material from outfalls, vessels or by other means, the removal of sand, coral shells, natural vegetation, seagrass or other substances, dredging and filling, land reclamation and mining or drilling for minerals, but does not include fishing, cultivation of crops, planting of trees and other vegetation and the construction and maintenance of coastal protection works by the CCD ...." (CCA, section 42) No permit shall be issued unless it is consistent with the Coastal Zone Management Plan and any regulations made in this regard and unless it has no adverse effect on the stability, productivity and environmental quality of the CZ. (CCA, section 15) Upon request of the Director, the applicant may have to submit an EIA relating to the development of the intended activity.(CCA, section 16) The duration of the permit will be defined by the Director and is renewable upon request.(CCA, section 18) The Director may vary or revoke the conditions for the purposes of proper management of the CZ. (CCA, section 19); (ii) a permits for the occupation of the foreshore ("that area of the shore of the sea between the Mean High Water and the Mean Low Water") or seabed lying within the coastal zone for any period not exceeding three years.(CCA, section 24)

[3] An EIA will be required in case of development activities that are considered to have significant impacts on the coastal environment. The applicant is responsible for preparing the EIA.(CCA, section 16) On receipt of the EIA from the developer, the Director submits a copy thereof to the Coastal Conservation Advisory Council for its comments. He also publishes a notice in the gazette indicating the place and time at which the EIA can be inspected by the public and invites the public to comment of the EIA within 30 days of the Gazette publication.

[4] CCA, section 15.

[5] See also annex 2, attached to this report.

[6] NEA, section 23Z.

[7] NEA, section 23AA(2).

[8] Ibid.

[9] National Environmental (Impact Assessment) Regulations, No 1 of 1992, Schedule I

It is the duty of the MFAR, as PAA to require from the aquaculture developer who submits a PP for its approval to submit an IEE or an EIA.[7] Beforehand, however, according to the DNER, the project proponent of any PP must submit to the PAA "as early as possible preliminary information (PI)[8] on the project requested by the PAA".[9] The PAA must acknowledge receipt of the PI within six days.[10] The decision as to whether an EIA or an IEE should be called for is entirely at the discretion of the PAA[11] and must be given in the case of an IEE within 14 days and in the case of an IEA within 30 days by the PAA from the date of acknowledging receipt of the PI.[12] Before it takes such a decision , the MFAR, as PAA, in consultation with the NEA, must subject the PI to environmental scooping[13] to decide on the Terms of Reference (TOR) for the EIA/IEE. In drafting them, it may take into consideration views of other state agencies and the public.[14] It may also decide, upon environmental scooping, whether the PI contains adequate information to be considered as an IEE.[15]

In both cases, IEE and EIA, the MFAR can grant approval with conditions or refuse approval (giving reasons).[16]

The conditions attached to the approval given by the MFAR to set up aquaculture operations at the end of the IEE/EIA procedure may relate to the following subject matters:

- the provision of "buffer" zone(s) around the aquaculture farm;
- measures to be taken in case of disease outbreak (early warning of authorities, etc);
- measures to be taken to avoid harmful interference with the surrounding activities and ecosystems (avoidance of soil erosion, seawater intrusion, etc.);
- the establishment of adequate drainage and discharge facilities;
- the prohibition to obstruct the natural watercourses;
- admission of Fisheries Inspectors on the sites;
- the collection of feed and post larvae from the wild;
- the collection of information for the relevant Government Authorities;
- the regular reporting by the aquaculturist; and
- the repristination of the site upon termination of the project.

The NEA and its regulations as well as the CCA constitute respectively legal basis to co-ordinate the control over on the one hand environment sensitive activities on environmental control and on the other hand all those activities occurring in the CZ. Under these texts, tools have been made available for the fish farmer to obtain protection, remedies and compensation for having suffered an injury due to major sources of water pollution. On the other hand, they set forth rules which ensure the protection and the control of the quality of the waters and which are likely to find application in fish farming activities, including shrimp farming. The CAE has set standards for emissions (discharge of effluents) into inland surface, brackish and marine coastal waters in particular for the discharge of aquaculture waste waters. Shrimp farmers may be required under the NEA to seek a licence[1] issued a licence to discharge, deposit or emit waste[2] into the environment and in keeping standards established under the NEA (section 23A).

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[1] Ibid., Reg.3(ii).

[2] contained in three schedules (II,III and IV)

[3] Draft Order under Section 23z of the NEA, No 47 of 1980, Schedule, Part 1

[4] Ibid.

[5] Ibid., Part II.

[6] Ibid., Part III.

[7] NEA, section 23BB(1).

[8] The Preliminary Information should include a description of the nature, scope and location of the proposed project accompanied by location maps and any other details as may be requested by the PAA. The National Environmental (procedure for approval of projects) Regulations, Reg.19.

[9] Ibid., Reg. 5.

[10] EIA Regulation 6(i).

[11] Ibid., 6(ii).

[12] Ibid., Reg. 6(iii).

[13] Environmental scoping is a term to describe the function of identifying issues and information needs that form in his case the contents of an IEE or EIA. The scoping applies to EIAs and IEEs and varies only in depth, duration and comprehensiveness. Ibid., reg.19.

[14] Ibid., 6(ii).

[15] Regulation 6(iv).

[16] Ibid., Regs 9 and 13.

*Guidelines*

Guidelines have been set up for the developer of an aquaculture project to ensure:

- sustainable development of aquaculture projects;
- prevention of pollution projects in the environment;
- that the project will not cause any environmental degradation.

They offer guidance as to the setting up of a fish farm, the proper operation of a farm and related duties in order to avoid environmental degradation, waste and effluent management. They address, in a confusing manner, the fish farmers to a large extent and the Government to a lesser extent. More they appear to concern shrimp farmers as well as other aquaculturists. As such, they aim at educating and ensuring that adequate consideration is given to the environment in developing the aquaculture projects and more specifically foreign investment aquaculture projects. They draw the attention of the reader to the following aspects of aquaculture development: the general procedures for establishing and operating aquaculture projects (they are indeed complex and lengthy), land allocation (setback rules and recycling systems), site selection (sensitive areas and the coastal zone), use of raw materials (fertilisers, juveniles, feeds, groundwater extraction), project design and construction (drainage and runoffs), water quality monitoring, waste disposal, progress reports and the restoration of sites upon expiry or cease of activity.

Those guidelines are legally non binding instruments. It is nevertheless expected from the aquaculturist that he will take the contents of the guidelines seriously and will give them some measure of respect.

*Administration*

The overall responsibility for the protection of the environment vests with the CEA, as the policy-making and co-ordinating agency on the environment according to the NEA. Its activities are largely oriented towards research, education programs and planning process on natural resources management and environment issues. In addition it should function as lead agency in scrutinising the planning and implementation of development projects which are likely to have an impact on the environment. Indeed, under the NEA, section 24, the CEA is empowered to (a) issue environmental protection licences, (b) to lay down conditions on which these licences may be issued, (c) to monitor whether these conditions are adhered to, and (d) to renew or revoke the licences.

At the local level, since the 13th amendment to the Constitution[3], places environmental protection is placed on the concurrent list and the provincial list. However, the listing on the provincial list confines the powers of the Provincial Councils to the sphere of environmental protection "to the extent permitted by law". Notable in this regard is the fact that, the NEA does not mention Provincial Councils as it was enacted before the 13th Amendment.

In addition to the CEA, the Ministry of Lands and Land Development is the single most important ministry responsible for water resources issues in Sri Lanka and covers all three major water resources development sectors namely land, irrigation and forestry. Further, overall responsibility for the conservation and protection of the coastal environment rests with the CCD under the CCA. However, its jurisdiction is limited to the Coastal Zone as defined in the CCA and where coastal areas are for instance protected under the Fauna and Flora Ordinance, the Department of Wildlife Conservation has an overall responsibility for the management and protection. The Ministry of Fisheries and Aquatic Resources and NARA are other government agencies having jurisdiction over the coastal areas in and outside the "CZ" as far as the management and the protection of the marine and inland aquatic resources are concerned.

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[1] The licence is known as the Environmental Protection Licence (EPL), National Environmental (Protection and Quality) Regulations, 1990, reg.5.

[2] The term refers to "any matter, whether liquid or solid, gaseous or radioactive, which is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration of the environment", NEA, section 33.

[3] Three legislative lists were established, one for Provincial Councils (PCs), one for the Parliament and one which is concurrent. Pcs have been established in all the provinces with the exception of the North and the East where a single Council functions on a temporary basis. PCs have wide legislative and executive powers covering public lands, police powers, environment, inter-provincial transport, irrigation, agriculture, etc. They have an exclusive right to legislate through "statutes" on matters specified in their list. Likewise Parliament has exclusive powers to legislate for those matters in the "Reserved List". PCs and Parliament can legislate on matters on the concurrent list provided it is done in "consultation" with each other. In the event of conflict between a statute and an Act of Parliament covered by the concurrent list, the PCs statute takes precedence within the province.

## India

Various laws and regulations in India are dealing with aspects of water quality, environment protection and pollution control which could apply to shrimp culture developments. These are the Environment (Protection) Act, 1986, the Water (Prevention and Control Pollution) Act, 1974 as well as the Fisheries Act, 1897, the Wild Life Protection Act, 1972 and the Forest Conservation Act, 1980. For instance, it appears that under the Environment (Protection) Act, 1986, effluents discharged by commercial shrimp farms could be covered by the definition of environmental pollutant, environment pollution and hazardous substance. The Water (Prevention and Control Pollution) Act, 1974 has been enacted to provide the prevention and control of water pollution and maintaining or restoring of wholesomeness of water. The term trade effluent under this Act includes “any liquid, gaseous or solid substance which is discharged from any premises used for carrying on any (industry operation, or treatment and disposal system), other than domestic sewage”. Shrimp farmers should obtain from the Pollution Control Boards an authorisation to set up any treatment and disposal system which is likely to discharge sewage or trade effluent into a stream or well or on land.

In February 1991 the Government enacted the Coastal Zone Regulation Notification. It applies to “coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action”. It is further limited by boundaries which reduce the regulated core area to the intertidal zone and an adjacent 500 metre wide strip of land from the high tide line. The seaward line is the low tide line. It regulates a whole series of activities and uses. India’s Coastal Regulation Zone is a good example of a coastal management law which is built around a set of exiting development realities. The core of the regulation is a moratorium on new construction, such as in ecologically sensitive area, and a prohibition of most development activities between the LTL and the HTL. The formulation of the rules is complex and sometimes unclear as if the Government did not want to compromise all economic development activities. The annex to the Notification classifies the intertidal zone and the landward area from the High Tide Line into four zoning categories, with fixed upland and offshore dimensions, and with different corresponding restrictions on construction and land use. Shrimp culture activities in these categories could either be excluded or authorised under special terms and conditions.

Given the federal structure of India, various State Governments have enacted coastal aquaculture legislation regulating the establishment of aquaculture in the coastal areas. This has been the case of the State of Tamil Nadu. The **Tamil Nadu** Aquaculture (Regulation), 1995 applies to all "coastal aquaculture units", institutes a general authorisation system for the setting up of coastal aquaculture units, sets up a eco-restoration fund, prohibits the location of aquaculture units in certain areas like wetlands, breeding grounds, sanctuaries, mangrove areas, areas committed to community conservation or production forestry . (reg.7). This areas fall within the concept of “prohibited area”. For the purposes of promoting environment friendly sustainable aquaculture activities it introduces a zoning system, prohibits to divert drainage channels of the Public Works Departments without a consent, obliges farms to be equipped with a effluent settlement pond and to use chemicals and drugs in limited manner (under the detection level at the point of effluent discharge). The licence is valid for 5 year and renewable and can be suspended in case of breach of the terms and conditions attached to it. Penalties in case of contravention may amount to 20.000 Rps and in case of repeated misconduct to 1.000 Rps for each day of continued contravention.

A particular feature of this Tamil Nadu Regulations is the constitution of an Eco-Restoration Fund. Deposits are made by the coastal authorised fish farms which contribute to the setting up of a Eco-Restoration Fund used for "correcting the imbalances caused to the environment by the aquaculture units".[i] It is operated by the Director, Tamil Nadu. In case of termination of the activities, for whatever reason, "eco-restoration works" have been carried out by the aquaculture unit concerned, 75% of deposit will be refunded. On the contrary, the Director will fund the works with the deposit.

The Government of India has also issued Guidelines for Sustainable Development and Management of Brackish Water Aquaculture. It operates a distinction between extensive brackish aquaculture (i.e. max. 2 tonnes/ha/yr) and semi-intensive and intensive culture (i.e. 5 tonnes/ha/yr - 2 crops) for the purposes of implementing the Guidelines.[ii]

The **Indian** Government Guidelines for Sustainable Development and Management of Brackish Water Aquaculture, recommend that shrimp culture units of 40 ha. or more provide for an EIA and incorporate an Environment Monitoring Plan and Environment Management Plan which covers the following:

- impact on the water courses in the vicinity;
- impact on ground water quality;
- impact on drinking water sources;
- impact on agricultural activity;
- impact on soil and soil salinisation;
- waste water treatment;
- green belt development;

Smaller farms >10ha but < 40 ha should provide detailed information on the above items. The latter is called "Environmental Impact Statement". Obviously, not all aquaculture systems, of any size, should be subject to an EIS and/or an EIA. We may also wonder why no reference is made to the need for a description and analysis of the natural environment prior to project start, to an assessment of the impact on public health, security, sanitary aspects nor to mitigating measures.

The **Indian Guidelines** are expected to be "useful in formulating appropriate shrimp farming management practices and adopting measures for mitigating the environmental impact for management of shrimp pond wastes and utilisation of the land/water resources in a judicious manner". The management practices and norms to be adopted by the shrimp farmers and the authorities are indicated contemporarily. They refer to: brackish water systems; impact on mangrove clearance; impact on land resources; feed quality and its management; shrimp pond wastes; the use of chemicals, fertilisers, pesticides, antibiotics; shrimp disease, production loss and environment; the introduction of new species; the social side effects of aquaculture; the creation of bufferzones; the enforcement of Government Rules/Acts; water and soil quality; source of seed and stocking densities; creation of awareness and enactment of a legislation. The conclusions include the Dos and the DON'Ts.

## Thailand[1]

### *Access to shrimp culture*

Since 1991, the Government of Thailand has introduced a shrimp registration system whereby all shrimp farms have to be registered. Registration implies that the farmer has a title to the land. General conditions attached to registration set a max. level of BOD in effluents to 10 ppm, prohibit the flushing of sedimentation of shrimp ponds in public waters as well as the release of salt water near the shrimp areas. Further, registered farms covering an area exceeding 8 ha are required to have a waste water treatment system and sedimentation ponds of not less than 10 % of the total pond area of the farm.

The scope of the registration system is to control the access and the management of the shrimp farms and avoid structures likely to harm the environment, to enable the authorities to collect statistics and to consult and assist farmers.

A zoning system has been introduced as means to direct farmers to settle in areas suitable for shrimp culture. In addition , the Government provides for these areas the necessary infrastructure and equipment including e.g. sea water irrigation systems. The zoning contributes to reduce user's conflicts, control impacts on the environment and to avoid mangrove destruction.

### *Administration of shrimp culture*

The Department of Fisheries, through its decentralised extension services provides free of charge a PCR diagnostic service (polymerase chain reaction diagnostic). Regular consultation and collaboration occurs with Universities and private firms in order to train local authorities and farmers in the subject matter.

The Department has established also 22 fisheries units at the coastal fisheries stations which provide mainly extension services. They visit the farms, consult with the farmers with regard to water quality, culture problems, collect information, etc.. This information is, as the need arise, forwarded to the central Government.

The control of the trade, use and distribution of some hazardous chemicals widely used in shrimp culture belongs to the Department of Fisheries.

Shrimp quality control laboratories have been set up in the coastal provinces. The laboratories work closely with the farmers in finding out antibiotic residues in shrimp catched or harvested and offer advice in the use of chemicals and drugs.

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[1] Source of information: Thailand: Dr. Atchara Wongsaenghan, Ph. D., Chief, Foreign Fisheries Cooperation Sub-Division, Department of Fisheries, Thailand. hattp://www.earthsummitwatch.org/shrimp/dratcha.

A specific feature of Thailand is the growing tendency of shrimp farmers associations to contribute to create awareness among the farmers and to the implementation and enforcement of state rules.

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Tamil Nadu Regulations for coastal aquaculture, 1995, section 8.

Government Guidelines for Sustainable Development and Management of Brackish Aquaculture, Ministry of Agriculture, Department of Agriculture and Cooperation, 11/9/1995.

This document contains the papers submitted by the FAO Secretariat, delegates, observers and resource persons to the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture, Bangkok, Thailand, 8 to 11 December 1997. The papers comprise background information and discussion guidelines by the FAO Secretariat, descriptions and analyses of shrimp culture development and management including legal and institutional aspects and government policies of several of the main producing countries, accounts of current activities and views on shrimp culture by several intergovernmental and non-governmental organizations, and a review of the literature on this subject focusing on development economics and socio-economics issues.

Este documento contiene los trabajos presentados por la Secretaría de la FAO, delegados, observadores y científicos especiales invitados a la Consulta Técnica FAO/Bangkok sobre Políticas para el Cultivo Sostenible del Camarón, Bangkok, Tailandia, 8-11 de diciembre de 1997. Los trabajos incluyen antecedentes de información y directrices para discusión por parte de la Secretaría de la FAO, descripciones y análisis de la ordenación y desarrollo del cultivo de camarón incluyendo los aspectos legales e institucionales y las políticas gubernamentales de varios de los principales países productores, informes sobre las actividades en curso y opiniones sobre el cultivo de camarón de varias organizaciones intergubernamentales y no gubernamentales, y un examen de la literatura sobre este tema con énfasis en la economía del desarrollo y cuestiones socioeconómicas.

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